· ENGINEERING NEWS-RECORD ·
DECEMBER 22, 1938

THE WEEK'S EVENTS

Water Strike Ends In St. Louis

Striking operating engineers go back to water plant on city's terms ending four-day strike

The strike of operating engineers in the St. Louis water department ended after four days on Dec. 16. Except for a period of a few hours on Dec. 15 when water was off in some sections of the city, there was no shortage of water during the strike.

The strike was settled on terms proposed by the city. Union leaders called off the strike and the city took back all of the strikers except thirteen who were judged by Public Utilities Director Edward E. Wall to have been responsible for the strike; these men were suspended, and their cases will be considered individually by Wall and water commissioner John B. Bean.

In addition to providing for suspension of some of the strikers, the strike setlement provided for maintenance of the status quo as regards jurisdiction of the two unions until the dispute is setled by the American Federation of Labor.

Jurisdictional conflict

The strike arose out of a month-and-a-half-long dispute between the operating engineers union and the firemen, oilers, and coal passers union, both affiliated with the AFL. The engineers claimed jurisdiction over various lower grade employees in the pumping plants known as apprentice engineers. These men had formerly been members of the firemen's union, and when a number of them joined the operating engineers recently they were laid off by the city at the request of the firemen. Month-long negotiations over the issue led finally to calling off the strike Dec. 12.

City recognizes union

The city of St. Louis, according to a statement to *Engineering News Record* by utility director Wall, has recognized both unions in their respective tasks for more than 25 years and "it has always been the custom of the city that whenever an employee was not in good standing in his union, his services with the city were terminated."

When the strike was called, all of the city's four pumping stations were shut down and reserve water from the reservoirs was turned into the mains. Within a few hours, however, service was resumed at three of the stations, the pumps being manned, according to director Wall, "by engineers who did not go out on strike and others employed in the water division." Members of the firemen's union cooperated in the operation of the plants.

Steam shut off

The one failure of service during the strike occurred when someone closed steam valves at the Baden pumping station. City officials charged this was done by a strike sympathizer, while union spokesmen said it was probably caused by someone not familiar with the machinery.

The strike was condemned in a statement by William Green, president of the AFL, and in another statement signed by twelve leaders of AFL unions in the city.

Charles Emery from Wide World

ART OR ENGINEERING?

ON THE BORDERLINE between sculpture and a construction project is the work at Mount Rushmore National Memorial, where sculptor Gutzon Borglum is carving on the face of a mountain the features of Presidents Washington, Jefferson, Roosevelt (Theodore), and Lincoln, shown above left to right.

FHA Mortgage Limit Up Fifty Per Cent

A billion dollars was added Dec. 13 to the total value of the mortgages which the Federal Housing Administration may insure. On that day the President exercised the option given him in the amended National Housing Act and increased the limit on the total value of FHA-insured mortgages which may be outstanding at any one time from $2,000,000,000 to $3,000,000,000.

Federal Housing Administrator Stewart McDonald had written the President that, on Dec. 1, FHA had already insured or committed itself to insure mortgages totaling $1,585,000,000 and that applications for mortgage insurance were being received at the rate of more than $100,000,000 a month so that it was clear that the mortgage insurance program would soon have to stop unless the President acted.

"It seems apparent now," the Administrator wrote, "that . . . 1938 will be the most prosperous home building year since 1929 . . ."

State Court Upholds Philadelphia Body

Authority which will take over city's water and sewage system is held constitutional

The Pennsylvania State Supreme Court early this month upheld the constitutionality of the Philadelphia Authority, an agency created by the city last summer to carry out a $60,000,000 PWA program of improvements to the city's water and sewage plants. The court's judgment was "rendered on the express condition" that a special sewer rental be levied sufficient to make the project self-liquidating and to avoid requiring any contribution out of the general tax levy.

Philadelphia authority

At a time when the city's bonded debt was crowding close to the constitutional limit and the city was threatened with the necessity for drastic tax increases to meet current expenses, the state attorney general last summer ordered the city to build sewage treatment plants and stop polluting the Schuykill River. The order was accompanied by a threat that if the city did not do so, the state would carry out the work and mandamus the city for the cost.

As a means of meeting the situation, the city council set up the Philadelphia Authority, with power to negotiate for PWA grants and to issue bonds to be retired from the revenues of its projects. The city plans to turn over the existing water and sewer systems to the authority and pay the authority an annual rental of $2,000,000. The authority has obtained a $27,000,000 grant from the PWA.

In its decision, the court held that the city's action in creating the authority "does not entrench upon any provision of either the state or the federal constitution." At the same time the court held that the municipality authority act, the state measure under the authority of which the city council acted, is constitutional.

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Abandonment of Dump Brings Rat Invasion

When Greenwich, Conn., three months ago installed a new rubbish incinerator and stopped dumping garbage on the city dump, it deprived the rats there of their accustomed forage. Consequently, the town is now overrun with rats.

The plague was first felt in the district near the dump, but the rats are now spreading over the entire town. Some of them weigh as much as 6 lb.

With the single exterminator in the town working overtime, an appeal for help has been made to the U. S. Biological Survey, and the town is appropriating funds to finance a study of the situation.

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New York City Regulates Water Conditioning

Designed to prevent mistakes or accidents which might lead to the contamination of the city's water supply, a new regulation has been adopted by the New York City Board of Health requiring concerns engaged in chemically treating water in buildings to obtain permits from the department. The regulation is directed specifically at the use of devices for water conditioning and corrosion treatment.

The new regulations are intended to apply only to water used for human consumption. Specifically exempted are treatment of water for industrial purposes, for swimming pools, for air conditioning systems, "or for any use which does not include human consumption."

According to Sol M. Pincus, deputy commissioner of the Health Department, the ruling also stipulates that permits will be issued only if graduate chemists or sanitary engineers are in responsible charge of all operations in connection with water treatment in buildings; such engineers must also have five years' experience in work involving the chemistry of water.

Half Urban U. S. Treats Sewage

Population served by treatment plants increases 52 per cent in three years

More than half the urban population of the United States is now provided with sewage treatment facilities, according to preliminary figures from a nationwide survey made by *Engineering News-Record*. This is a gain of 52 per cent in the three years since the last survey was undertaken. Disposal plants were constructed in 1,200 communities during this period.

The complete inventory, which is being compiled from official data furnished by state sanitary engineers, will be published in January. It is a factual summary of progress and trends in sewage disposal—the third to be made by *Engineering News-Record* since 1929. It will include information for each of the 48 states on the number of people and communities served by sewers and treatment plants and the number and type of disposal plants as well as a detailed tabulation showing the major processes of treatment now in use.

Preliminary totals indicate that there are 4,662 communities served by treatment plants, and the connected population to these plants is 40,885,000. The latter represents 53 per cent of the urban population of this country.

Delmont Wilson Photo

CHICKAMAUGA DAM NOW IN LAST COFFERDAM STAGE

LEE WARREN, boss of the TVA Chickamauga Dam near Chattanooga, has his big project right on schedule. Construction operations are now centered in the third and last cofferdam, which will contain the powerhouse section and 3½ bays of the spillway.

This view, looking across the powerhouse area toward the spillway and locks, shows concrete foundation operations in the last section well under way.

At upper left is the central mixing plant, beyond the lock walls, from which concrete is delivered.

Westchester Water Plan Opposed in Watershed

The plan of Westchester County, suburban area near New York City, to develop a new source of water from Conocus Creek, Oscawanna Brook, and Clove Creek, in Putnam and Dutchess counties (*ENR*, Dec. 1, 1938, p. 686.), is being opposed by county authorities in the watershed areas. The supervisors of Putnam county on Dec. 17 passed a resolution asserting that further acquisition of water rights by communities outside of the county would be harmful. The resolution asked Putnam County representatives in the state legislature to secure legislation prohibiting outside municipalities from acquiring water supply in the county by condemnation.

In addition, the water commission of Peekskill, N. Y. and authorities of Dutchess County are expected to file objections.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week, $86,597,000, are the highest for any week this year, 44 per cent above last week, and 93 per cent higher than for the corresponding 1937 week.

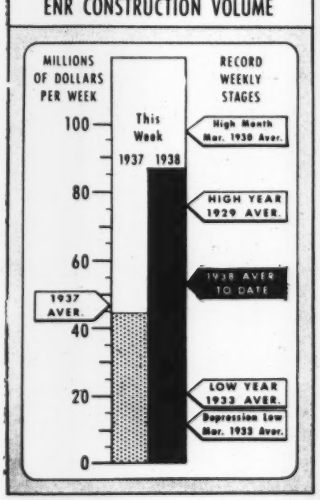
Construction volume for the year to date, $2,732,421,000, is 14.2 per cent above the volume for the 51-week period last year.

The week's public awards are 45 per cent above last week and 146 per cent above the 1937 week. Private construction shows a 38 per cent gain over a week ago, but is 7 per cent below a year ago.

Three large sewerage projects in California and Missouri are partially responsible for the highest weekly sewerage total since November 21, 1935. Waterworks reached its third highest level of the year as a result of an $11,432,000 contract for a portion of New York City's Delaware Aqueduct tunnels. In addition to these two classes of construction, industrial buildings, commercial buildings and large-scale housing, earthwork and drainage, highways, and unclassified are above last week. All groups except industrial buildings gain over the week last year.

New capital for construction purposes for the week totals $49,471,000, an increase of 66 per cent over the corresponding week last year. The current week's total is made up of $29,330,000 in USHA loans for slum clearance projects in 12 cities, $17,205,000 in state and municipal bonds, and $2,936,000 in corporate security issues.

New construction financing for 1938 to date totals $3,679,637,000, 68 per cent higher than the 51-week volume for the 1937 period.



CONTRACTS

(Thousands of dollars)

	Week Ending Dec. 23 1937	Dec. 15 1938	Dec. 22 1938
Federal	$9,112	$7,171	$10,614
State & Municipal	20,180	42,664	61,625
Total public	$29,292	$49,835	$72,239
Total private	15,493	10,373	14,358
TOTALS	$44,785	$60,208	$86,597
Cumulative 1938 (51 weeks)	$2,732,421		
1937 (51 weeks)	$2,392,654		

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 51 Wk.	1938 51 Wk.
NON-FEDERAL	$1,444,011	$2,535,942
Corporate securities	516,983	375,784
State & Mun. bonds	518,963	736,457
PWA loans, grants	178,126	723,265
RFC loans	29,939	101,844
U.S.H.A. loans	.....	320,986
R.E.A. loans	.....	76,106
Federal Aid-highways	200,000	201,500
FEDERAL	$746,223	$1,143,695
TOTAL CAPITAL	$2,190,234	$3,679,637

FHA MORTGAGES

	Week Ending Dec. 18 1937	Dec. 10 1938	Dec. 17 1938
Selected for appraisal	$7,781	$19,818	$19,000*
Cumulative 1938 (50 weeks)	$978,221*		
1937 (50 weeks)	$581,612		

* Subject to revision.

ENR INDEX NUMBERS

Index Base		1913	1926
Construction Cost	Dec.	234.89	112.87
Building Cost	Dec.	196.07	105.99
Volume	Nov.	199	87

Equipment Purchases Upheld by Court

Colorado highway engineer may buy road equipment without taking competitive bids

Chief highway engineer Charles D. Vail of Colorado is entitled to purchase road machinery without calling for bids, the district court of Denver held in denying an injunction against the purchase which had been sought by the Colorado Businessmen's Tax Association.

The case arose after Vail bought $258,000 worth of maintenance equipment from various Colorado machinery firms. A requisition itemizing this equipment was approved by the state executive council, but, when questioned by a Denver machinery concern, members of the council said they were under the impression the requisition they had approved was for regular monthly expenditures.

Shortly thereafter the tax association sought an injunction against consummation of the purchase, calling attention to a requirement in state law that all orders awarded or contracts made by the state purchasing agent be awarded to the lowest bidder.

At hearings on the suit, plaintiffs brought out that equipment bought previously on competitive bids had been cheaper. Vail said that he wished to avoid purchasing equipment which, though meeting the specifications, might be inferior.

The court found "in all matters—facts, law and equity—for the defendant". In the decision, the court held that in the state administrative code "there is a certain discretion that is reserved in the purchase as to the kind and character of materials desired—a discretion reserved for the head of the department making the purchase."

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Nebraska District Acts To Buy Utilities

Two of the three Nebraska power districts which are planning to purchase the private utilities in the state in order to form a unified statewide system have taken their first definite action in that direction. The Tri-County and Loup districts voted Dec. 17 to authorize a bond issue of $26,500,000 to buy the Iowa-Nebraska Light & Power Co. of Lincoln, the Southern Nebraska Power Co. of Superior, and part of the Northwestern Public Service Co. of Columbus. The combined facilities involved represent about a seventh of the state's power plant.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

HOPE that an early agreement on the construction of the St. Lawrence waterway would be reached between Canada and the United States was expressed Dec. 9 by President Roosevelt. Receiving a delegation from the National Seaway Council, the President said, "For many years it has been my sincere conviction that the St. Lawrence project would prove second to none in its direct contribution to the economic welfare of millions of people on both sides of the border."

INTERPRETIVE Bulletin No. 6, issued a fortnight ago by the Wages and Hours Administrator (*ENR*, Dec. 15, 1938, p. 745), mentioned companies engaged in renting construction equipment, building contractors, and oil well drilling contractors as among the types of industries which could not claim exemption from the fair labor standards act under the clause exempting service establishments. In this same bulletin, the administrator held that engineering was not a service within the meaning of the act.

NEGOTIATIONS are in progress between the commissioner of reclamation and the contractors at the Grand Coulee Dam looking to the installation of heating equipment that will allow the work to continue throughout the winter. It will be necessary to protect the concrete against temperatures as low as zero but the output must not fall far under capacity if the dam is to be completed in 1940.

Another reason for keeping the work going is to maintain at the present level, as nearly as is possible both direct and indirect employment. Inability to secure delivery on the generators will make it impossible to make power available before 1941.

Arrangements are being made to speed up concrete placing next summer. It is planned to exceed the record-breaking rate established last summer.

MANUFACTURERS of road building machinery are conferring with officials of the Export-Import bank in an effort to secure aid in the financing of sales to Latin American countries. The negotiations still are in a preliminary stage but it is expected that some plan will be worked out that will make possible a greater volume of road-building equipment exports.

Wide World Photo.

NEW APPROACH TO WASHINGTON BRIDGE

WORK is proceeding actively on a new approach section to the George Washington Bridge over the Hudson River in New York City. The new approach will connect, through a tunnel under Washington Heights, with a parkway along the Harlem river.

In the foreground above is the temporary roadway which has been placed over the entrance to the tunnel.

Truck Breaks Through Bridge in Oklahoma

Two spans of the Bixby Bridge on Highway 64 across the Arkansas River in Oklahoma collapsed Dec. 9 under the impact of a semi-trailer truck. Both the truck and a sedan following it, dropped into the river, but no one was injured.

The Bixby Bridge consists of thirteen 170-ft. pin-connected through trusses with a clear roadway width of 16 ft. Built by Tulsa County about 30 years ago, it was condemned two years ago, repaired, and later reopened subject to weight restrictions. A new bridge to replace it is now under construction, but will not be open for another four or five months. Repair of the collapsed bridge is not planned.

The failure of two spans of the bridge, the third and fourth from the south end, was apparently caused when the truck collided with a vertical member on the fourth span. The impact caused the member to buckle, throwing excessive strain on the other members, and the failure of this truss broke off the top of the pier support at the fixed end, causing the adjacent truss to fall into the bed of the stream.

Concrete Pavement Laid On Queensboro Bridge

Placing of a reinforced concrete pavement on the upper level of the Queensboro Bridge, New York, was completed Dec. 19, and traffic was admitted for the first time since Oct. 3. Carried out as a WPA project, the job, which was completed four and a half months ahead of schedule, cost $461,000.

The Queensboro bridge, said to be the most heavily traveled in the world, has now been completely repaved, the lower level having been finished in June, 1937, at a cost of $1,028,000.

The repaving project involved removal and disposal of an existing granite block and wood block roadway. In addition to construction of the reinforced concrete slab pavement, the work included reinforcing of existing steel stringers, installation of four new expansion joints, construction of a drainage system and installation of a permanent traffic line between lanes.

Over the main spans, a 3-in. slab reinforced with a 2½-in. I-beam lock steel mat is used, while on the major part of the approaches a 5-in. slab is employed reinforced with 3½-in. steel truss mats welded to an existing ½-in. steel plate roadbed. At the entrance approaches a 5-in. concrete slab is used reinforced with two layers of welded steel reinforcing fabric; this slab is laid on top of an existing 6-in. reinforced concrete roadbed.

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Sixteen More Contracts Made for Housing Loans

Ninety-per cent housing loans which will provide for construction of about 5,933 family dwelling units were completed Dec. 16 by the U. S. Housing Authority, the agency agreeing to loan $29,330,000 to twelve cities to cover sixteen low rent housing projects. The amount of USHA funds actually contracted for was thus brought to $320,986,000.

The largest of the new contracts provides for an $8,390,000 loan to the New York City Housing Authority, which will build a $9,323,000 project, probably in east side Manhattan. The New York authority has already received a $30,000,000 loan contract under which it is building the Queensbridge and Red Hook projects.

New Orleans received a loan of $7,070,000, bringing to $25,311,000 the total loans contracted for with that city. Loans ranging from $1,296,000 to $2,000,000 were made to Charleston, Columbus, Ga., Reading, Pa., San Francisco, and Savannah, Georgia.

Robert Ridgway Dies, Subway Builder

Participated in ground breaking ceremony for new Chicago subway system on Saturday

Robert Ridgway, consulting engineer, died at Fort Wayne, Ind., on Dec. 19, following a heart attack which he suffered while returning from participating in the ground-breaking ceremony Saturday for the Chicago subway. Ridgway was taken from his train to the hospital in Fort Wayne on Sunday, having suffered a coronary thrombosis. He was 76 years old.

In August Ridgway was appointed by Secretary Ickes to serve as a member of a four-man commission of engineers to report on a proposed subway system for Chicago to be financed with PWA funds.

Born in Brooklyn, N. Y. in 1862 and educated in the public schools of that city, Ridgway began his professional career in 1882 on railway surveys in Montana and Wisconsin, but in 1884 he returned East to accept a position as instrument man with the Aqueduct Commission of New York City. From that time until the turn of the century he devoted his attention almost exclusively to New York City's water supply system. After 1900 his activities were enlarged to include the city's rapid transit system.

Ridgway's abilities as an engineer were recognized early. In 1886 he was made assistant engineer for the Aqueduct Commission on the location and construction of the aqueduct, dams, and reservoirs of the Croton system. In 1900, as the construction of New York City's first subway system was getting under way, Ridgway was engaged by the Rapid Transit Railroad Commission to be senior assistant engineer on the difficult work of building the subway through the 42nd St. region and under Broadway. Two years later he was made division engineer in charge of the more difficult section connecting Manhattan and Brooklyn.

With the establishment of the Board of Water Supply in 1905, Ridgway returned to water supply work as division engineer for the board. He was placed in charge of construction of the northern aqueduct department on the Catskill system, which included the deep pressure tunnel under the Hudson River. He remained in charge of this work until its practical completion in January 1912 when he again took up subway work as engineer of subway construction for the Public Service Commission. In 1921 he was appointed chief engineer of the Transit Commission, and when the Board of

ROBERT RIDGWAY

Transportation was established in 1924 to build the Independent Subway System, Ridgway was made chief engineer. He held that position until 1932 when he was appointed consulting engineer to the board, a position which he relinquished upon his retirement from city service in 1933.

In 1916 Ridgway was appointed a member of the Chicago Traction and Subway Commission, and since that time had served frequently on studies of the Chicago subway problem. He also served as a member of the Colorado River Board on studies of the Boulder Canyon project, as chairman of the board of engineers for the Transbay bridge project at San Francisco in 1927, as consulting engineer to the Port of New York Authority on vehicle tunnel work and on numerous other consulting boards. He was president of the American Society of Civil Engineers in 1925 and was elected to honorary membership in 1934.

AUGUST C. FRANKE, employed for eighteen years by the Port of New York Authority as a civil engineer, died Dec. 12 in Passaic, N. J., at the age of 59.

JAMES S. WATTS, inventor of various waterworks devices including a chlorinator and a device for injecting softening solutions into pipelines, died in East Orange, N. J., Dec. 16 at the age of 57. Until about 9 years ago he lived in Nova Scotia and Montreal.

ROLAND B. WOLSEY, for many years secretary of the Engineers Club in Toronto, died there Dec. 13. Wolsey was secretary of the Association of Professional Engineers of Ontario from 1908 to 1915, and later was secretary

(*Continued on page* 778)

Engineers Uphold State Water Rights

Association of Western State Engineers holds three-day annual meeting in Phoenix, Ariz.

"An apparent desire on the part of some federal agencies to control water rights within the states" was vigorously attacked by State Engineer Edward Hyatt of California, at the eleventh annual convention of the Association of Western State Engineers meeting in Phoenix, Ariz. Dec. 8–10. "The danger is greater now than ever before," Hyatt said, because of present large federal expenditures for water projects. He attacked the 1938 flood control act because of its elimination of local participation.

The position which the federal government is taking in the La Plata River interstate compact case now before the Supreme Court—that title to all unappropriated western water vests in the federal government—was attacked in a paper read by Charles J. Bartholet, supervisor of hydraulics of the state of Washington. Pointing out that the legal question involved is "perhaps unimportant" Bartholet said that the federal government has no means of sharing with the state in an orderly allocation of water rights and that present procedure should not be upset.

The convention adopted a resolution opposing the federal position and asserting "that the waters of these nonnavigable streams are dedicated to the use of the people of the state . . . and that all federal agencies . . . shall conform in all respects to the laws of the respective states."

A second resolution opposed future establishment of national parks or monuments without consideration by all agencies concerned, including state officials, and "then only with an express provision for rights-of-way for construction . . . of water-use projects."

Colorado River Water

Governor R. C. Stanford of Arizona appealed to the delegates to aid that state in obtaining a share of water from the Colorado River. Arizona has never ratified the Santa Fe compact covering use of the river by basin states.

T. H. Humpherys, Utah state engineer, was elected president of the association. Charles J. Bartholet was elected vice president and Walter C. Burnham, chief engineer of the Oklahoma State Water Conservation Board, was elected to the executive committee. Selection of next year's convention city was referred to the executive committee.

Stevens Receives Hoover Medal

Award recognizes work on Panama Canal and on Siberian railways

John F. Stevens, 85 year old consulting engineer of Baltimore, is to be the first civil engineer to receive the Hoover Medal according to an announcement made by the Hoover Medal Board of Awards. The award is to be made at the annual meeting of the American Society of Civil Engineers in New York, Jan. 18. It is in recognition of his work as chief engineer on the Panama Canal and also his work with the Inter-allied forces in Siberia during the World War. Instituted in 1930 during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, the medal has previously been awarded to former President Herbert Hoover and to Ambrose Swasey.

Stevens' work on the Panama Canal was a high point in a career which at that time had included 30 years of railway work in the West and Middle West, including positions as chief engineer and vice president of the Chicago Rock Island & Pacific and chief engineer and general manager of the Great Northern Ry. After two years on the canal, Stevens became vice president in charge of operations of the New York, New Haven & Hartford, later was president of the Spokane, Portland & Seattle and the Oregon Trunk Ry., and in 1911 began a consulting practice.

Stevens has stayed in consulting work since that time with the exception of six years in Siberia. There he served first as chairman of the Commission of Railway Engineers sent there by the United States to aid the Kerensky government in operating the Siberian line and later as president of the Inter-Allied Technical Board with headquarters at Harbin, Manchuria. He has been decorated by the United States, French, Japanese, Chinese and Czechoslovak governments and is a holder of the John Fritz medal. In 1927 he was president of the American Society of Civil Engineers.

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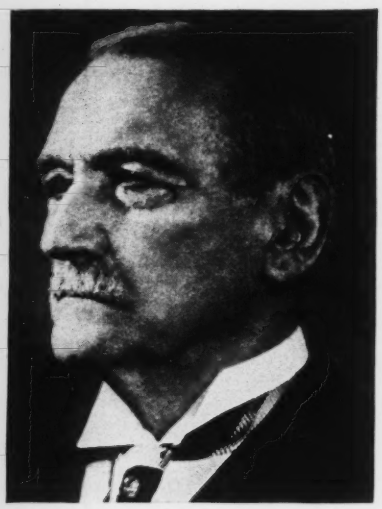
Robert Ridgway Dies

(*Continued from page 777*)

and registrar of the Ontario Association of Architects.

EDWARD CROWLEY, a structural engineer formerly employed at the Boston Navy Yard, committed suicide in Boston Dec. 12 as a result of financial reverses. Crowley, a graduate of Harvard School of Architecture, was 35.



JOHN F. STEVENS
receives Hoover Medal

E. T. KEEFE, president of the Underground Steam Construction Co. of Boston, died Dec. 1 in Newtown, Mass. Before beginning his 15-year connection with the Underground Steam Co., Keefe operated an engineering and contracting business under his own name.

CLIFTON A. GLASS, 62, consulting structural engineer of Kansas City until his retirement five years ago, died Dec. 9 at Flin Flon, Manitoba. Before beginning his consulting practice, Glass was connected for many years with the Kansas City Structural Steel Co.

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New Contract Let For El Razing

The New York City Board of Estimate on Dec. 19 voided the sale of the Sixth Ave. elevated structure which it was to have made to a West Coast wrecking firm (*ENR*, Dec. 8, 1938, p. 715) and immediately arranged a new contract to sell the structure to the Harris Structural Steel Co. of New York.

The original sale, for $80,000, was voided after representatives of the West Coast firm had failed to deposit the amount of the $80,000 bid and the required $45,000 performance bonds.

The Harris company is buying the structure for $40,000 under a contract which stipulates that the scrap metal shall not be sold to any foreign nation except Great Britain. The company had offered to pay $44,500 if the stipulation were omitted.

In accordance with the new sale contract, demolition of the El began on the morning of Dec. 20 at the corner of 53rd St. and 6th Ave., with Mayor LaGuardia applying a torch to one of the trusses.

LABOR NOTES

IN RESPONSE to repeated inquiries, PWA Administrator Ickes on Dec. 3 reiterated that PWA has no regulation requiring that workers on a project be either union or non-union. Inquiries originated because of press statements about labor difficulties on a PWA project at Decatur, Ill.

WORKERS on a $3,000,000 intercepting sewer project at Rock Island, Ill. went out on strike early this month charging that pipe used on the job was manufactured by a non-union concern and hauled by non-union trucks.

A DEMONSTRATION by more than a thousand members of Central Illinois AFL unions shut down early this month a levee building project on the Sangamon River near Oakford. The work is being done by the S. W. Hardwick Construction Co., and the unions claim that the company is bringing in non-union workmen from out of the state. The Hardwick firm insists they are paying union scale. At mid-month the dispute was still under way but expected to reach an early solution.

EMPLOYMENT of a non-union man by an electrical contractor on a dormitory building project for the University of Kentucky at Lexington resulted in a strike of 50 or 60 men Dec. 12. General contractor on the project is the W. S. Owens Co. of Louisville.

A WAGE INCREASE from $1.10 to $1.25 per hr. was sought by iron workers on the Baton Rouge Bridge across the Mississippi River in Louisiana who went on strike Nov. 28 and were still out the middle of the month. The contractor involved is the Steel Construction Co. of Birmingham.

THE INTERNATIONAL Association of Bridge, Structural and Ornamental Iron Workers, AFL, has been certified by NLRB as the sole collective bargaining agency for employees of the Belmont Iron Works of Royersford, Pa.

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Ohio Mayor Suspends City Engineer

City engineer T. F. Lininger of Conneaut, Ohio, has been suspended from his post with the city by Mayor Naylor, who charged Lininger with incompetency on ten counts. The charges, which Lininger denied, included variations in curb elevation and failure properly to estimate the cost of a street improvement program.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Storage for the Rio Grande

Sir: Your story on the Lower Rio Grande water situation (*ENR* Nov. 3, 1938, p. 555) is a splendidly written and accurate portrayal of the situation and will undoubtedly be a valuable contribution to the campaign now being waged to solve a critical situation for the people of this section. Prominent old-time residents are a unit in acknowledging that your data are perfectly correct and that you have done the Lower Rio Grande Valley a great service in bringing it out at this time.

Without any desire to minimize the seriousness of the situation, it is suggested that the picture is not one of all shadow. It is true, as you bring out in your story, there is a group of citizens in the Valley, mostly those with land to sell, who put the soft pedal on when a sour note is struck. On the other hand, there is another group, and a much larger one, composed of earnest and far-seeing men who have the future prosperity of the Valley at heart. This latter group several years ago organized the Lower Rio Grande Valley Conservation Association, composed of one representative from each canal system, each Valley city, the Associated Chamber of Commerce, the Brownsville Navigation District and the Port Isabel and San Benito Navigation District. It has held regular meetings and is very active in directing the campaign to solve the water problem. In conjunction with the proper Texas state officials it has not only been in constant touch with the federal Department of State but has also had conferences with the President and Vice-President.

In your article you conclude that the proper solution of the situation indicates regulating reservoirs. This is also the conclusion of the association, and is the line of their attack. They do not, however, propose to secure those reservoirs by means of dams across the river, but rather by so placing them on the Texas side that will permit flood waters to flow into them by gravitation, and then to conduct the water so impounded to the desired section by means of gravity canals entirely on the American side. Thus dams will be avoided and no treaty violated.

I am informed that federal funds are now in the hands of L. M. Lawson, U. S. Boundary Commissioner, for a complete survey of possible locations for these reservoirs, and that such survey will be made at an early date.

Naturally the cost of the construction of reservoirs and canals required by the plan will be considerable, but probably no more than that of building retaining dams in the river. The importance of the preservation of the sustaining industry of an entire section of the country should be sufficient to warrant the financial cooperation of the federal government irrespective of its political complexion.

H. J. LEACH
Los Fresnos, Tex.

Sewers in Quicksand

Sir: The sewer project here has now laid 3,056 ft. of 10 in. sewer line on a gravel-packed subgrade as described in *ENR*, Aug. 18, 1938. As work advanced away from the creek, not so deep a gravel pack was required; there were a few short stretches, none of them 100 ft. long, where no quicksand was encountered.

Gravel packing this 3,056 ft. of line has required 266 cu. yd. pit run gravel, which cost 5¢ per yard at the pit and was hauled a mile.

I noticed the report of Mr. McDonald's experience using dry marsh grass (*ENR* Nov. 17, 1938). Here at Killdeer the gravel is much the cheapest material, because the seven-year drouth that has prevailed on Dakota's western slope has left the land so dry that Russian thistles grow only two inches high, and marshes where coarse grass might be gathered have disappeared.

Whatever method is used, the idea is to keep the subgrade as compact and solid as possible until the ditch is backfilled. Quicksand, if kept confined, is sufficiently stable to support a sewer. Should the sewer leak, so that groundwater enters the line, carrying fine sand with it, the gravel-packed line will be found superior, in that not nearly so much sand can enter the sewer; it is held back by the gravel-pack, similarly to the way fine sand is held back by the gravel-pack in a gravel-packed well.

The job previously reported is located at Great Bend, Kansas, and was built about 1910; none of the gravel-pack line there has needed relaying since the sewer was put in service. J. S. Morrison, of that city was one of the contractors who finished the job.

R. F. MIRICK
Construction Engineer
Killdeer, N. D., Nov. 25, 1938

Highway Costs

Sir: I note in the Dec. 8 issue of *Engineering News Record* an editorial entitled "Rise of the Earth Road." In this editorial the following sentence appears:

> "Some developments suggest, however, that the original term 'low-cost roads' no longer can be applied generally to modern earth roads, for some of the construction procedures used in building stabilized soil roads are fully as complex and costly as those required to lay a concrete slab pavement."

Our experience and observation of son, chief engineer of the South that these operations are anywhere near as costly as those required to lay a concrete slab. It is true that the operations are somewhat complex, but with the exception of the traveling mixing plant, the machinery is not expensive and usually is already available in the locality where the work is to be done.

In Dallas this week, J. S. Williamson, chief engineer of the South Carolina State Highway Department, reported that the costs of their soil stabilization work varied from thirty to fifty cents per square yard for thicknesses which ranged from four to six inches after consolidation. This applied to projects on which tar was used, and also the projects on which cement was used.

These figures indicate that the cost of the soil stabilization is certainly less than that of a cement concrete pavement slab.

GEO. E. MARTIN
Engineer, The Barrett Company
New York, Dec. 9, 1938

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Editorial Offices at 330 West 42nd Street, New York

DECEMBER 22, 1938

FIRST-SPADE CEREMONIES last week carried out the promise that dirt would fly on the Chicago subway before the new year. Coming on schedule, the event harmonizes with the remarkable record of speed already made by the Chicago subway group as outlined in this column two weeks ago (Dec. 8, p. 715). It remains to be seen whether, even with so prompt a start on construction, it will be possible to complete the undertaking in 18½ months, as the law requires. The task seems all but impossible; yet the all but impossible has already been accomplished in creating a complete project to the point of actual construction within 3 months' time. There is a real chance that Chicago will set a new record of performance also in excavation and concrete work.

Irvin Works

DEDICATION of the new Irvin Works of the Carnegie-Illinois Steel Corp. near Pittsburgh last week marks the completion of the country's largest industrial project in recent years. Of particular interest to our readers is the wide variety of civil engineering and construction problems involved in building this modern rolling mill. First was the preparation of the site, which required moving 5,000,000 cu. yd. of material to cut and fill 215 hilly acres to one level tract. Then there was the building of foundations to carry the heavy rolling units, and the erection of huge buildings to house them. Lastly, easily overlooked by all except those directly interested, is the vast array of utilities needed to serve the manufacturing operations and a mill population of 7,000. Irvin Works shows why industrial building means so much to the construction industry.

Strong-arm Stuff

MILLIONS OF DOLLARS and the best thinking of waterworks experts have been expended to assure the reliability of water service in St. Louis. Safeguards, stand-by duplicate equipment and emergency facilities of every description have been provided so that there will be no interruption of this vital utility service. But no one reckoned with jurisdictional quarrels in a union—and so it came to pass last week that pumping operations were brought to an abrupt halt by a strike. The officials of the union who called the walkout should be proud of that achievement. Their tactics resulted in a virtual 24-hour ultimatum—we get what we are after or the 800,000 citizens of the city don't get water when the reservoir reserve runs dry. Nothing like strong-arm stuff of this kind to win the admiration and support of the public to the union cause. What does it matter that the life of the entire community is jeopardized? A union has a quarrel to settle—that comes first! Just ask any citizen of St. Louis.

Engineering Not a Service

ENGINEERING is not a service and so is not exempt from provisions of the wage-hour act, according to a recent interpretative bulletin issued by the administrator of the act (*ENR* Dec. 15, p. 745). Section 13 of the act specifically exempts "service establishments", and these are described by Deputy Administrator Sifton as agencies which "are usually local in character and render a service to the ultimate consumer for direct consumption . . . for private use rather than industrial or business purposes". Grouped with engineering under the administrator's list of firms not coming within the service-establishment classification are toll bridge companies, water, gas and electric utilities, firms making geological surveys, concerns renting construction equipment and building contractors. As to whether any of these agencies come under other sections of the act is not yet clear, but it will be wise for engineers, equipment dealers and utilities whose activities are anything other than purely local to revamp their working schedules to meet the limitations of the wage-hour act.

A New Old Tool

THE DEVELOPMENT of the sheepsfoot roller is notable in the field of construction equipment. Invented a full generation ago this device, after a little use in southern California roadbuilding, had scant attention for nearly three decades, only to come into prominence in the last five years with present developments in soil compaction. Specifically real roller development began with presentation by R. R. Proctor of the principle of direct relation between the moisture content of soil, the degree of compaction and the resulting density. New thought has modified these principles and improvement of the roller design and construction has come about from the work of the engineers of the U. S. Bureau of Reclamation and particularly from their experience on the All American Canal. The findings on the canal work as presented by Mr. Kadie of the canal engineering staff on a following

page establish new standards of sheepsfoot roller design and rolling procedure that demand careful observance.

Modern Reclamation

THE OUTSTANDING national development enterprise, reclamation of the arid West by irrigation, today operates under conditions much more severe than those of earlier years. Formerly it could develop good farming areas at costs ranging from $50 to $100 per acre; the projects of today require development expenditures two or three times as great. It is questionable whether the principles and practices of the past can be made to work under these conditions.

Complaints from water users, reiterated every few years, say that they are unable to carry out their obligation to repay the cost of the irrigation works, and as a matter of fact in more than 30 years' time only one-fifth or one-sixth of what the government has spent to build the works has been repaid. This makes it appear that the Reclamation Act has not been particularly successful in bringing about prosperous land development, and is not likely to succeed better in the future.

Attempting to deal with some of the current troubles, a Repayment Commission recently recommended changes in reclamation finance. It proposed to make the government a share-cropper, taking a percentage of the crop income; to eliminate contracts with the district or Water Users Association, letting the government deal with each farmer separately; to allow various discounts in debt payment; and to authorize review of contract and reduction of payment at any time on request of the debtor.

Thus the commission would make the government's investment subject to an indefinite obligation of return. Such indefinite obligation is a poor basis for a sound development enterprise. But the very fact that the difficulties with the present law gave rise to these proposals indicates that the law itself needs to be modernized.

Reclamation has been subsidized by the government from the beginning, in accordance with world-wide experience. But the amount of the subsidy has never been fixed. In practice it amounts to roughly half the construction cost. Despite this public contribution, however, complaints of inability to pay and requests for debt adjustment are frequent. In all probability they would be increased rather than diminished by placing the farmer's debt on a flexible basis and thereby making it indefinite.

Modernizing the law would require as first reform a change from the now hidden and indefinite federal contribution to an explicit grant of definite amount. Next, the obligation to pay the local contribution must be binding, exactly as in case of an amortized farm mortgage. And finally, the money obligation must be handled by a banking rather than an engineering organization as now. The Reclamation Bureau, a construction agency, should not also be a tax collector.

Were the Reclamation Act modernized along these lines, it would provide a definite test of when a proposed irrigation undertaking is sound and worth building. Such a test is badly needed. It would make possible a definite determination of the merit of a project, and the uncertain and usually political discussions of "economic feasibility" required under the present law would be eliminated.

For 30 years tinkering with the reclamation law has been relied upon to fit the statute to practical needs, but reclamation difficulties have not decreased, as the studies of a long succession of inquiry commissions and boards have shown. It is now time to modernize the law by complete rewriting in harmony with present-day project requirements, in order to continue the development of the arid West and protect the nation's water resources and the people's savings from waste.

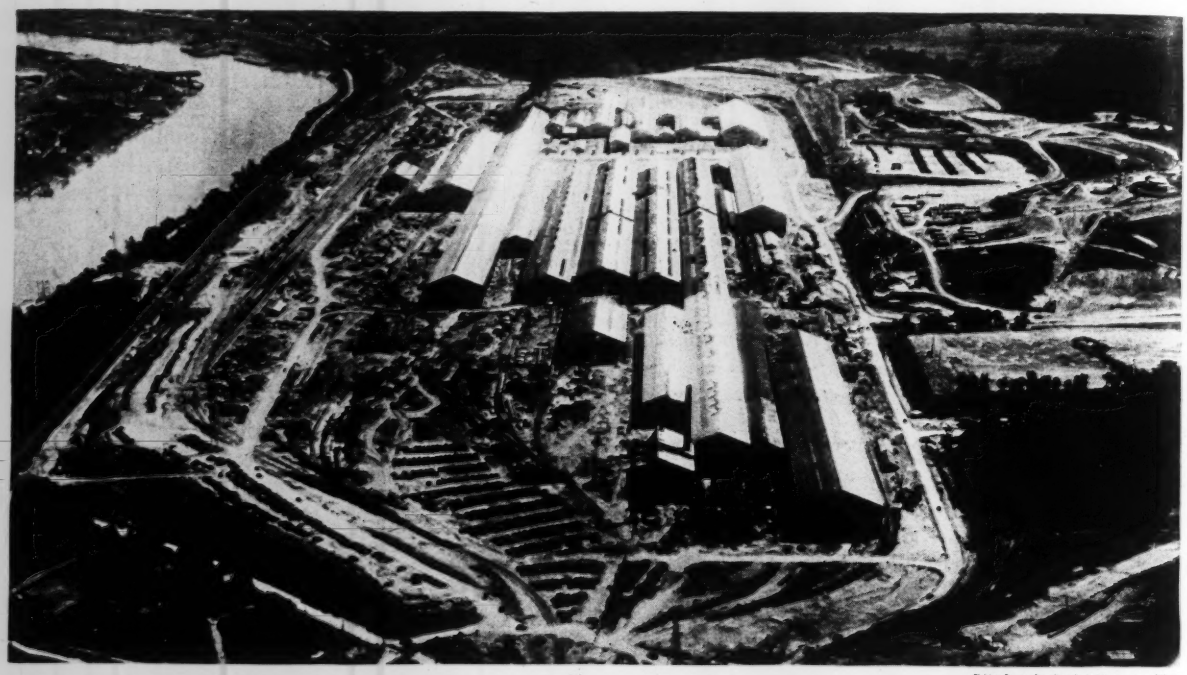
Robert Ridgway

IT IS HARD to realize that Robert Ridgway is gone. To those of us who were fortunate enough to meet him frequently in the course of our daily life it seemed that we were always to have him with us, always available for kindly counsel and sound advice. A lifetime of experience in meeting the small as well as the great engineering problems of aqueduct building and subway construction and in working with men under conditions that bring native ability to the fore had given Mr. Ridgway a rare wisdom and keen understanding which now will no longer be with us.

Typical of the man, much of his energy in the years since he began to curtail his active engineering work has been devoted to helping the young men of the engineering profession. No call to speak to a group of young men or to sit in as their plans were being discussed was turned down if he had the physical strength to meet it. As a consequence, many young men of the profession know Robert Ridgway both as a great engineer and as a personal friend. His is indeed a unique record.

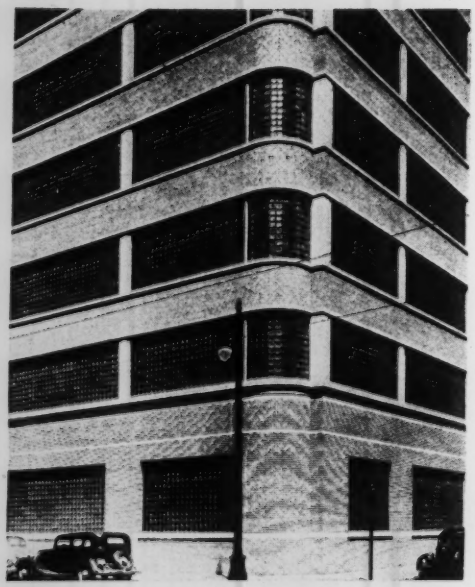
And the manner in which the record closed is as unique as the record itself. Long recognized as the nation's foremost authority on subway construction, Mr. Ridgway had participated during the past 22 years in the recurring attempts to develop a subway system for Chicago. On Saturday he took part in the ground-breaking ceremony that marked the end of planning and the start of actual construction. Death came as he was returning to his home in New York. Surely Robert Ridgway himself could write "Finis" on that record with no regrets.

PICTURES IN THE NEWS



Pittsburgh Aerial Surveys Photo

LAST WEEK saw the opening of Carnegie-Illinois Steel's Irvin Works, on high land bordering the Monongahela River 13 mi. above Pittsburgh. Occupying a site over a mile square, it includes two buildings that are almost a half-mile long. The story of the grading for this job, the most extensive ever done for a building, is told in ENR *Nov. 11, 1937, p. 781. An article on the plant's services begins on the opposite page.*



EFFICIENT OFFICE BUILDING. Engineers of the Detroit Edison Co. utilized the insulation and diffused light features of translucent glass block in designing their new air-conditioned building. The insulation permits use for natural lighting of large wall areas without undue transmission of outside temperature, and the diffused light permits lighting at considerable depths into the building without discomfort due to glare to occupants near the outside.

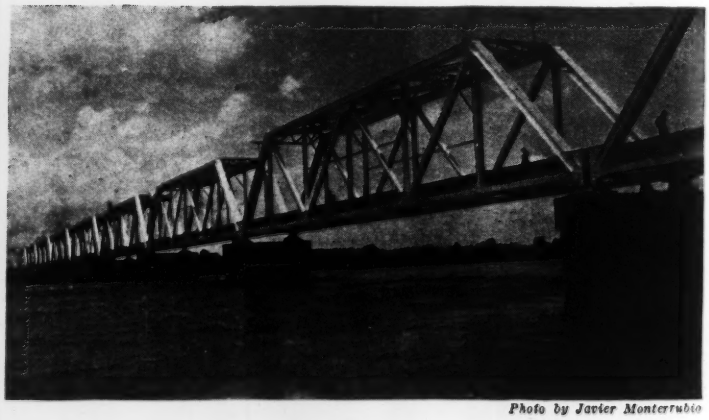


Photo by Javier Monterrubio

MEXICAN RAILROAD BRIDGE. Replacing wooden bridges that were destroyed annually during spring floods, this nine-span truss bridge carries the Mexico City-El Paso line of the Mexican National Railways across the San Pedro River in Chihuahua. Two spans are 175 ft., and the others are 150 ft. Piers are founded on a compact layer of clay 43 to 49 ft. below the concrete cap. Bethlehem Steel Co. fabricated and erected the steel.

FIG. 1. TRUNK SEWERS AT IRVIN WORKS ARE AS LARGE AS THOSE IN MANY CITIES

Utilities For a Vast Industrial Plant

Water, sewerage, power, and transportation facilities required special planning in the new Irvin Works of the U. S. Steel Corporation

On CAMDEN HILL overlooking the Monongahela River near Clairton, Pa., is the new Irvin Works, latest addition to the Carnegie-Illinois group of steel mills and largest current industrial construction job in the United States.

Starting with only the fact that a mill of 1,000,000 gross tons per year capacity was to be built on a newly graded site (*ENR* Nov. 11, 1937, p. 781) over which the soil conditions varied widely, the engineers first laid out the plant to provide an orderly flow of materials through structures placed where foundation conditions were best. With the main units of the plant laid down, buildings to house them and utilities to serve them were designed and built. This article relates to the utilities, water supply, sewage disposal, power and communications.

Among the first considerations in designing the plant were the storm sewers, requiring about 38,000 ft. of pipe. Sizes of sewers were determined from the run-off rate from the building roof area based on a maximum precipitation of 4 in. per hour. From the ground, only 30 per cent of the above runoff was figured. Main trunk sewers from the plant to the river, 200 ft. below, are on steep grades. However, they were not reduced in size as would have been possible due to the increased slope, but were maintained full size to preclude any possibility of clogging at a reducing section and to avoid increasing the velocity and causing abrasion of the pipe. Main sewers are of precast reinforced-concrete pipe with terra-cotta lining in the bottom half. Trunk sewers range in size from 36 in. to 72 in. Heavy-duty reinforced-concrete pipe is used for crossing under railroad tracks and roadways; cast iron pipe is used for crossings where extreme shock and ground vibration exist.

For the sanitary sewers vitrified tile pipe is used throughout, except under buildings, where extra heavy cast-iron soil pipe is specified. No sewers are smaller than 6 in. The trunk sewer, a 24-in. line, has a capacity of 2½ m.g.d. when running half full. The maximum sewage flow for the entire project will be about 350,000 gal. per day, with peaks occurring three times every 24 hr. Nearly three miles of sanitary sewers are required.

A trickling filter type sewage disposal plant was built between the mill and the river, designed to handle the wastes from a mill population of 7,000. The average daily flow was estimated at 35 gal. per capita, and the design provides for handling a peak load of 150 per cent of normal flow. The sludge digestion tank, 40x100 ft., has sufficient capacity for a seven months accumulation of sludge; the sludge drying bed provides 0.35 sq.ft. of area per capita. The rate of sewage application on the 75-ft. diam. filter bed will not exceed 2,000,000 gal. per acre per day. The entire system is so designed as to provide for expansion to double the original capacity. Disposal of acid waste from the various processes involves a system of special acid resisting sewers and a separate plant for diverting this type of waste.

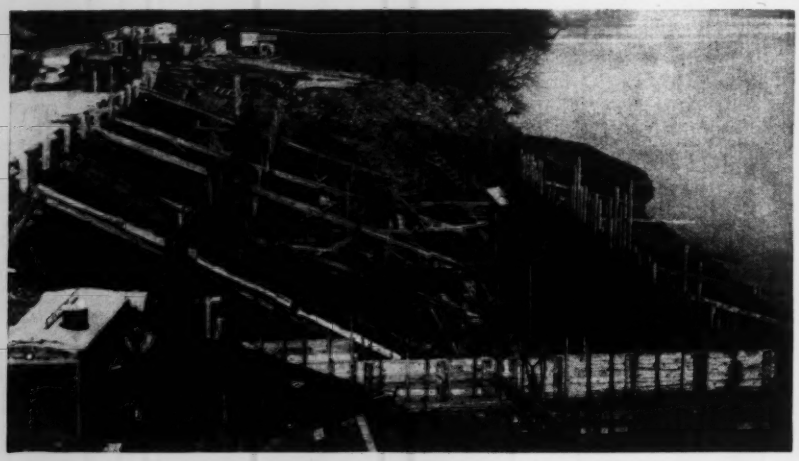


Fig. 2. Industrial water supply will be pumped from the Monongahela River to a filter plant high above the mills. This is a view of the pumphouse during construction.

Water for the mill will be provided from two sources, a pump house at the river, and the mains of the Monongahela Valley Water Co. which supplies Clairton and the surrounding towns. Connection to the Clairton 12-in. loop is through a 6-in. concrete line. Water from the river will be pumped from El. 718 to a 3,740,000-gal. circular steel reservoir on the hill at El. 1,100. Capacity of the reservoir is sufficient for four hours supply.

The pumping plant, of modern design and appearance in keeping with other buildings, is of unusually heavy construction to withstand the hydraulic pressure on the walls and the tendency to float during high water. It is designed to withstand a flood 10 ft. above El. 748.5, the crest of the 1936 flood. Special 300-lb. automatic cone valves and high-pressure pipe are necessary for the main riser to the reservoir because of the 420-ft. pumping head. The 42-in. riser line is a 250-lb. steel pipe below El. 865; above that elevation is 150-lb. pipe.

Lime is added to the river supply at the pump house ahead of the pumps as a preliminary treatment, and immediately after the water passes through traveling screens. Addition of lime neutralizes the acidity of the water and assists in maintaining a pH from 7 to 9; this corrective treatment will minimize corrosion of piping and equipment. Lime is introduced from a 100-ton storage bin into the water by means of continuous automatic lime slakers with feeders controlled by a pH control meter.

Raw water is pumped to the reservoir for settling. From here the greater part of the transfer is by gravity. Some of the facilities using raw water after settling are the furnace skids, descaling sprays, boiler house, and closed cooling coils throughout the mill. The remainder of the water is filtered and used for hot mill cooling sprays, pickling, cold finishing, cleaning, etc., on all processes beyond the hot strip mill where water comes in contact with the product, and for the toilets, lavatories and showers.

Because of the corrosive properties of the water, the steel pipe for raw and filtered water is at least 1/16-in. heavier than is necessary for pressure requirements alone. All pipe 4 in. and smaller is specified extra strong because of the reduction of metal due to threading. Couplings 6 in. and larger are of the flexible bolted type. Welded construction is specified wherever practical. Bitumastic coating was called for on the outside of all pipe 6 in. and larger. Orifice fittings were specified for meters where the line cannot be taken out of service for replacing orifice plates. All valves were specified with bolted bonnets, seats and disks of dissimilar stainless steel and stems of stainless steel.

Conditioning of raw water is by an all-steel Morse filter plant of 6,000,000 gal. per day capacity (Fig. 4). The filtration system includes two mixing chambers, two sedimentation basins, four filters, and a covered 250,000-gal. wash water storage tank on a 50-ft. tower. Welded steel construction is specified throughout the entire plant; the bottom and roof of all tanks are lap welded, the sides butt welded. The diameter of the sedimentation basin is 131 ft., that of filters 53½ ft. A control house of the same diameter as the filters and directly over them, will provide chemical storage and office and laboratory space. Insulation of the walls is 1½-in. corkboard, for the roof is rock wool. The four filters will each have a capacity of 1,500,000 gal. based on a filter rate of 3 gal. per sq.ft. per min.

Transportation facilities

Transportation of raw materials, finished products and supplies necessary to maintain and operate a plant the size of Irvin Works is a big problem. The Union R.R., a subsidiary of the U. S. Steel Corp., will carry most of the traffic. Some 50 miles of track are necessary for yards and for access to buildings on the mill property alone. Outside connections with the Union R.R. are made through the Pennsylvania R.R.

Material flow throughout the plant will be in a continuous direction, terminating at depressed-track railroad loading docks and truck-loading platforms where tractors will run at floor level directly into cars to effect a rapid and efficient loading. Equipment and products which must be loaded and unloaded by crane will be handled from tracks and docks located within convenient reach. Bulk oil, gasoline, palm oil, etc., delivered in tank cars, will be transferred by pipe to storage tanks at strategic points throughout the plant. A 200-ton track scale is located in the yard, and several scales in the various departments will facilitate proper scheduling and accounting of shipments.

Light and power

Electric current for light and power is supplied by a new Duquesne Light & Power Co. 66,000-v. transmission line serving additional slabbing facilities being installed at Edgar-Thomson Works and the outdoor substation at Irvin Works. The new power supply will be a 60-cycle circuit as distinguished from the existing 25-cycle lines in the same area. Located at the north end of the hot strip mill building is the main high-tension outdoor substation, from

which power will be distributed throughout the plant by underground tunnels and ducts at 6,600 v. to three major load centers over two separate routes; each route having sufficient capacity to carry the total load.

Aside from conventional building lighting, 236 mercury vapor lights are intended for use on production lines where close inspection of the product is necessary. Outside lighting is by means of high candlepower floodlight clusters on 50-ft. towers for purposes of illuminating track yards, parking space, roads and property surrounding the plant proper. Spare conduits will be provided for expansion of all electrical facilities.

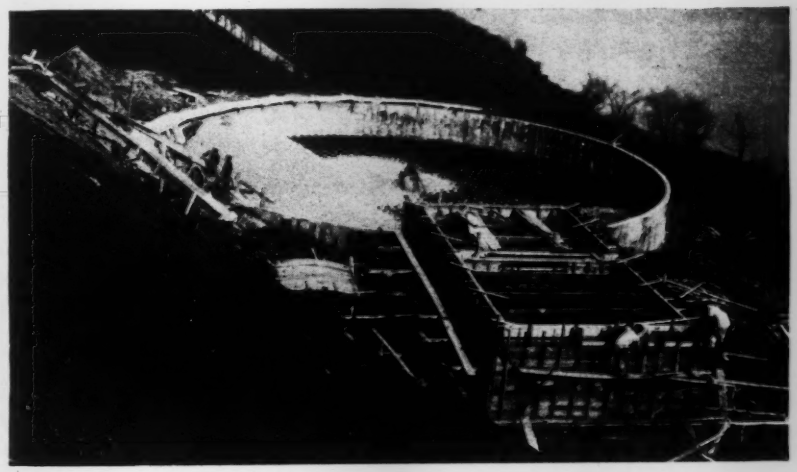


Fig. 4. Industrial and sanitary sewage will pass through this treatment plant before being discharged into the Monongahela River.

Fuel supply

There are three slab heating furnaces scheduled with provision for additional furnace capacity. The furnaces will burn coke oven gas, each requiring about 120,000,000 B.t.u. per hour, when heating slabs to 2,250 deg. F. Waste flue gases from the furnaces are conducted to individual 200-ft. stacks or induced by fans through two gas-tube waste heat superheaters and boilers to produce 60,000 lb. of steam per hour each at 200-lb. pressure. There are, in addition, two fuel-fed boilers utilizing either coke breeze or coke oven gas or a combination of both, each designed to furnish 60,000 lb. of steam per hour at 200 lb. pressure. Steam coils will be used throughout for heating the building, tanks and other plant. All of the steam generating facilities are designed for future extension of the plant without interruption of service.

The boiler house is equipped to burn either coke oven gas or coke breeze or a combination of both and will be automatically controlled when operating with any combination of fuels. Both fuels will emanate from the Clairton Coke Plant. An interesting feature of this supply is that spent natural gas fields in the vicinity have been harnessed and are used for storing quantities of coke oven gas during periods of light consumption. As much as 600,000,000 cu.ft. of the gas has been stored at one time. After storage, the gas is found to increase in both heating value and volume. Coke breeze is also a by-product of the coke process and will be delivered to Irvin Works in cars and unloaded and fed to the boilers by automatic handling equipment.

An important facility is the communication system, making possible the coordination of all the integral parts into a working unit. There will be two telephone systems. The Bell system alone will include some 400 phones and a private exchange system for rapid access to key points in event of emergency. Also, a part of the communication system is a series of paging signal lights making the foremen available at all times. Fire alarm signal stations are located at convenient places. Where possible, all telephone and signal wiring is carried in ducts alongside electric wiring to simplify construction. Provision is made for future expansion of all equipment. Switching and generating equipment is located in the basement of the mill office building.

There are fifteen principal mill buildings located throughout the plant, each with sanitary and locker facilities for not over 150 men per shift. All sanitary facilities are greatly in excess of state sanitary requirements. Steam heated unit heaters will be used to provide comfortable working conditions. Where gases given off by processing equipment are detrimental or undesirable to the workers, fume exhaust systems are considered as much a part of the equipment as the actual production equipment itself. All buildings are brightly illuminated by means of skylights and high candlepower lights, and are equipped with ventilators in the walls and roof to insure a circulation of clean air at all times.

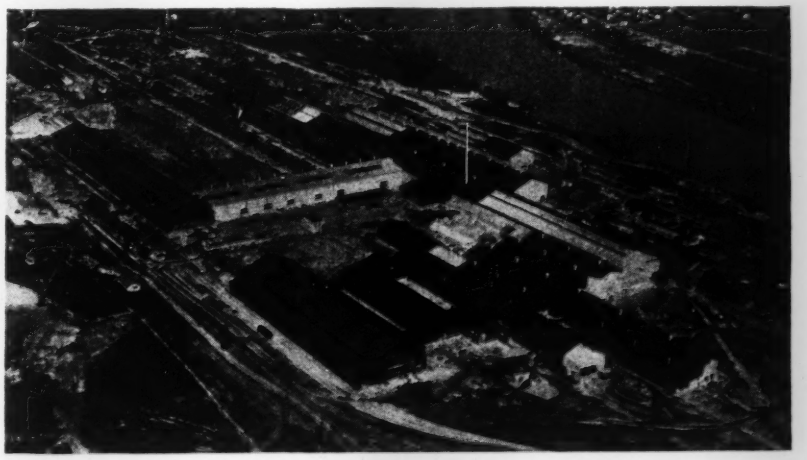


Fig. 3. On a man-made plateau high above the river, Irvin Works is a new idea in steel mill location.

A COMPACTING OUTFIT OF ROLLERS, ROCK PICKER, BULLDOZER AND WATER TRUCK ON THE ALL-AMERICAN CANAL

Tailored Sheepsfoot Rollers

CARL H. KADIE, JR.

Assistant Engineer, Bureau of Reclamation, Boca Dam, Boca, Calif.

Experience with sheepsfoot-roller compaction on the All-American Canal develops a tailored design for the Shasta Dam

A REQUIRED DESIGN of tamping roller (sheepsfoot) to be used for the rolled earth and rock fill at Shasta Dam (*ENR*, May 5, 1938) has been developed by Bureau of Reclamation engineers as a result of experience on the All-American Canal and other projects involving compacted earth. The article is limited to the findings on the canal that are typical of experience on other projects. The large number of borrowpits used facilitated a broad study of the action of rollers in different materials on the canal.

At Shasta there are about 350,000 cu.yd. of rolled fill, of which about 100,000 cu.yd. are rock from 5 in. down. The new roller is designed to handle this rock material as well as the finer earth fill. The design changes were indicated by laboratory tests on compaction and experience in rolling fill from the coarser pits on the canal work.

Rock influences compaction

A long explanation of laboratory procedure is not included, but merely a presentation of the general findings. It has been customary in the laboratory work with compaction material to refer to those sizes between ¼ in. and 5 in. as rock and that smaller than ¼ in. as soil. A material can be well graded and test to a high soil density but fail to produce this soil density in the fill due to the presence of a large proportion of "rock" interfering with compaction. The soil-plus-rock density will be considerably above the soil density of the fill, but only slightly above that density found under standard laboratory compaction. With the purpose of improving the roller specification, data were accumulated on this interference. The results were plotted and curves as shown in Fig. 2 were obtained.

The purpose of the curves is to show the effect of rock on the soil density and on the total density. To eliminate all variations due to factors other than rock, all laboratory cylinder densities have been corrected to 120 lb. per cubic foot. Proportionate changes have been made in both the fill and soil-plus-rock densities. Hence, actual values of densities have no real meaning; but the slope and peaks of the density curves are influenced only by the amount of rock present. For the particular material (and rolling equipment) it will be seen from Fig. 2 that an increase in the total (or soil-plus-rock) density is realized with a rock content up to

41 per cent. At 47 per cent of rock the interference with compaction is such that a decrease in the total density is apparent. The soil density is not decreased with rock up to 34 per cent.

The number of tests supporting a particular point may be read at the left of the distribution curve and the cumulative per cent of tests plotted up to a particular point may be read to the left of the curve so labeled. Density values are shown at the left

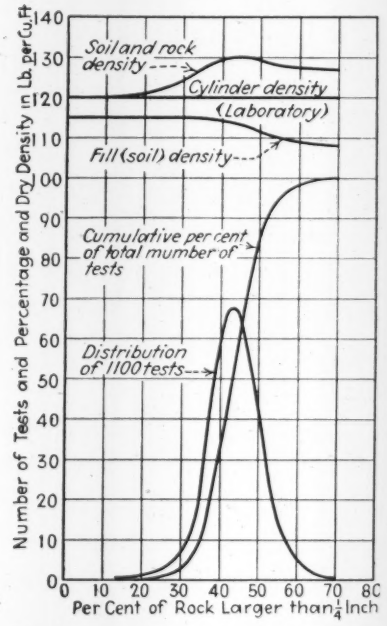

Soil and rock density
Cylinder density (Laboratory)
Fill (soil) density
Cumulative per cent of total number of tests
Distribution of 1100 tests
Number of Tests and Percentage and Dry Density in Lb. per Cu. Ft.
Per Cent of Rock Larger than ¼ Inch

Fig. 2. Test curves indicating the effect of rock on soil density.

of the three density curves, and the per cent of rock for any point on the five curves is shown on the graph as the abscissa.

While the per cents of rock at the critical points of these curves are of real meaning, it should be borne in mind that for other materials and equipment the same phenomenon will be produced, but probably the curves will be quite dissimilar in slopes and critical points. The grading of the material, its friability, and the degree of compaction applied are all-important factors in the development of these curves.

Rollers on the canal

About 3,000,000 cu.yd. of rolled earth fill on the All-American Canal as described in a preceding article (*ENR*, Oct 20, p. 487) were compacted by sheepsfoot rollers. As indi-

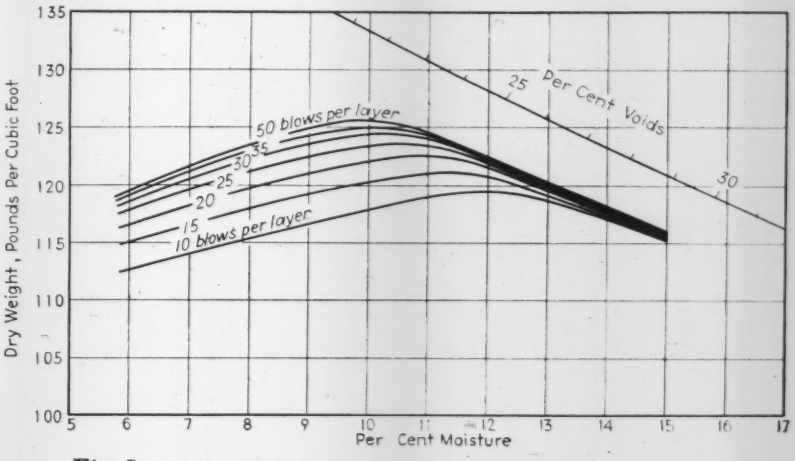


Fig. 3. Density-moisture curves for different degrees of compaction.

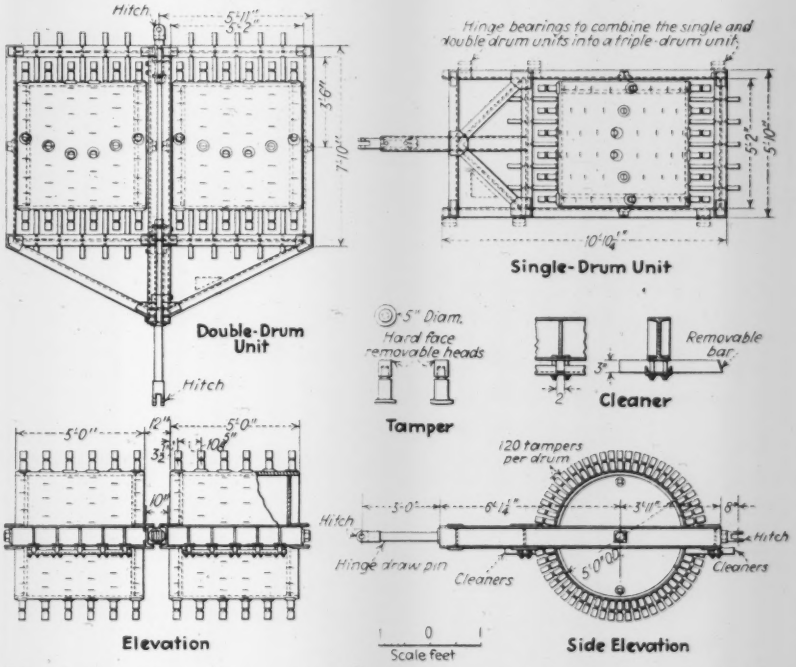


Fig. 4. Sheepsfoot rollers specified for Shasta Dam; design is based on rolled-fill earthwork on the All-American Canal.

cating common roller practice and to some extent changed specification influence, the accompanying table is instructive. The roller specifications for the canal work were broad and were changed with new contracts as experience developed. There was no detailed design of roller as at Shasta Dam. The specification requirements were:

That the total weight of the roller and ballast be such that the unit weight on one row of feet parallel to the axis of the drum be 250 lb. per sq. in. (this was moved up to 300 and later to 340 lb. per sq.in.); that proper cleaners be mounted on the roller (the last specifications required oscillating drums); that the feet be not less than 6 sq.in. in area (in a few cases about 6 sq.in. were required); and that the feet be 7 in. long. The spacing of the feet in most cases was such that there was one for each square foot of cylindrical surface as determined by the outside diameter (outer end of feet) of the roller.

As will be noted, the later contracts called for heavier rollers than were required at first. This was necessary because of ungraded material and

CHARACTERISTICS OF SHEEPSFOOT ROLLERS USED ON THE ALL-AMERICAN CANAL

Contractor	George Pollock Construction Co.		Sharp & Fellows	A. S. Vinnell	Geo. W. Condon Co.	Lewis Constr. Co.	David H. Ryan	
No. of trips	6	6	10	12	12	12	12	12
Per cent coverage	50	50	50	49.5	54.5	56.6	67.2	96.3
Rolling based on coverage (C) Trips (T)	C	C	C	T	T	T	T	T
No. of rollers	1	1	1	1	3	3	1	1
No. of drums per roller	2	2	2	2	2	2	2	2
Length of drums	48″	48″	48″	48″	48″	48″	48″	48″
Diameter of drums (outside)	46¾″	50½″	39″	40″	42″	40″	40″	40″
Knob (K) rectangle (R) or square (Sq.)	R	R	Sq.	R	R	K	K	K
No. of horiz. rows of feet	32	22	20	14	16	16	24	32
No. of feet per row per drum	3 & 4	4	4	4	4	4	4	3 & 4
Total No. feet per drum (k) x (1)	112	88	80	56	64	64	96	112
Length of feet	7¼″	7½″	7½″	7″	7″	6¾″	7½″	7½″
Dimensions of bottom of feet	2¼ x 3½″	3 x 3.06	2 x 3″	2 x 3″	2″ x 3″	2″ x 3″	1¾ x 3¼″	2″ x 3½″
Area of bottom of feet	7.87 sq. in.	9.18 sq. in.	6 sq. in.	6 sq. in.	6 sq. in.	6 sq. in.	5.7 sq. in.	7 sq. in.
Weight of roller (empty)	12,200 lbs.	10,300 lbs.	6,280 lbs.	9,620 lbs.	5,500 lbs.	4,850 lbs.	11,180 lbs.	7,010 lbs.
Ballast capacity (all drums)	60 cu. ft.	72.3 cu. ft.	56 cu. ft.	58 cu. ft.	75.2 cu. ft.	68.1 cu. ft.	68.1 cu. ft.	68.1 cu. ft.
Weight of roller (as used)	15,750 lbs.	18,360 lbs.	13,460 lbs.	16,800 lbs.	12,000 lbs.	12,000 lbs.	12,000 lbs.	14,000 lbs.
Ballast used (material)	Water and Steel Shafting		Sand & Water	Sand & Water	Sand & Water	Sand	Sand	Sand
Weight of roller / Total area of all feet (sq. ft.)	17.9	22.7	15.1	25.0	31.3	31.3	21.9	17.8
Type of frame, rigid or oscillating	Rigid	Rigid	Rigid	Oscillating	Rigid	Rigid	Rigid	Rigid

coarse material. In two cases it will be found that rolling was required in terms of 50 per cent coverage and that in most of the remaining cases 12 trips yield about 50 per cent coverage. This coverage is determined by finding the number of passes required to cover one-half of the rolled surface with the feet of the roller—assuming that a foot does not strike the same place twice. A roller 8 ft. wide and 4.75 ft. in diameter (measured to the outside edge of the feet) will cover 119.2 sq.ft. in one revolution. If the total area of all of the feet on the roller is 5.3 sq.ft. (16 horizontal rows, 4 ft. per row per drum, 2 drums, 6 sq.in. per each foot), the passes for 50 per cent coverage can be obtained by dividing 59.6 by 5.3, which results in a requirement of 12 passes.

The advantage of a heavy roller in eliminating interference with compaction due to rock has been shown. On a fill constructed of any type of material a light roller is a detriment to the contractor and to the fill. This is brought out by a simple series of curves developed in the laboratory and shown here as Fig. 3. It will be seen that the less the compaction force (or degree of compaction) the less is the density, the greater is the optimum moisture and the less is the resistance to penetration. With the concentration of loads present when 10 to 16-cu.yd. trucks are present, a great deal of cutting of the fill and even bogging down of this heavy equipment occurs when the optimum moisture is high. Since low densities are not desirable, nor is light, small capacity hauling equipment, the solution is simply the adoption of a roller which provides a degree of compaction at a reasonable number of passes which will result in a low optimum moisture requirement. That this is more economically secured by increasing the weight of the roller rather than by increasing the number of passes is borne out by observation.

Since writing the successive roller specifications for the All-American canal the Bureau of Reclamation has developed specific plans (Fig. 4) for a roller which the contractor for Shasta Dam is required to use. On this work, as has been stated, there will be rolled rock fill and rolled earth fill. The rolled rock fill is the unusual item. This material is rock under 5 in. and rock fines placed in 8-in. layers, regulated to optimum moisture content and rolled.

The All-American canal work is under the direction of the U. S. Bureau of Reclamation, John C. Page, commissioner, Washington, D. C., and R. F. Walter, chief engineer, Denver, Colo.

Concrete Pumped 220 Ft. High

With the aid of a booster pump 140 ft. above ground, concrete was delivered to a height of 220 ft. by concrete pumps on the new postoffice and court house now under construction at Los Angeles. The building is 130x380 ft. in plan for the first seven stories and thence to the fifteenth floor the dimensions are 80x330 ft. The frame is of structural steel; floors, walls and partitions are of concrete.

The concrete plant on the ground floor was equipped with two 1-cu.yd. mixers designed for continuous operation at a rate of 60 cu.yd. per hour. From the mixer concrete was discharged to a "Pumpcrete" unit delivering through a 7-in. pipe directly into forms. As work progressed this method of delivery was continued up to the eleventh floor (140 ft. above the pumping unit). At this level a booster pump was installed with which delivery was continued to the top of the penthouse, a total height of 220 ft. above the pump on the ground.

FIG. I. INTRICATE PATTERN OF HUGE ODD-SHAPED STONES FORMS NEW BREAKWATER AT MARQUETTE, MICH.

Heavy Breakwater Built in Fast Time

Extensive quarry operations and large floating plant speed up construction of harbor protection at Marquette, Mich.

OFF A WIND-SWEPT POINT in Lake Superior's Presque Isle Harbor at Marquette, Mich., The Merritt-Chapman & Scott Corp. is building for the U. S. Engineers a rubble stone breakwater 1,600 ft. long in fast time. As much as 2,000 tons of stone, produced in a quarry 3 miles inland from the job and rail-hauled to the shore, has been transferred to barges and placed in the breakwater in a single day. Large-scale quarrying, well coordinated with a smooth-working schedule of stone placing by adequate floating rigs, account for the excellent progress being made. By Oct. 15 about 55 per cent of the stone was in place, though less than one-third of the contract time had elapsed.

Years ago the army engineers had given part protection to the north end of the harbor by building a filled-crib breakwater 1,216 ft. long, extending southeast from Presque Isle Point. This wall, however, failed to give the desired protection to the harbor, especially to an important ore dock of the Lake Superior & Ishpeming R.R. The current project extends the old breakwater for 1,600 ft., giving it a total length of 2,816 ft. Though the extension is only partly completed, the new wall already has a noted effect in protection of the harbor, indicating its desired purpose will be accomplished.

Design

Alternate bids were taken on a rubble stone breakwater, and one of stone-filled timber cribs capped with concrete; contract was awarded on the rubble design. The theoretical cross-section is a 12-ft. top width 8 ft. above water level, side slopes of 1½:1, and 12-ft. berm at each toe. Water depth varies from 15 to 42 ft., and much of the bottom is ledge rock. The structure consists of a core of stone under 10 tons in size, covered by a minimum thickness of 5 ft. of stone 10 tons and over, (Fig. 2). Of the 200,000 tons of stone required, about 60 per cent is of core designation, the rest is cover.

Rigid specifications govern the size, shape, quality and placement of the stone. The rock must weigh at least 165 lb. per cu. ft., must be dense, sound, free of fissures and not subject to loss in weight from abrasion in handling. For durability test, a sample is crushed and screened, then is subjected to baking for 4 hr. at 105 deg. C., followed by soaking for 20 hr. in a saturated solution of sodium sulphate. After five such cycles the loss on further screening must not be more than 12 per cent. The specifications also subject all stone to "any freezing and thawing tests considered advisable by the contracting officer."

Cover stone is specified at 10 tons minimum size, and the least dimension must be at least one-third of the greatest dimension. Not less than 50 per cent by weight of the core stone must weigh at least one ton, and not more than 12 per cent may be under 50 lb. Clay, soil and stones under 1 lb. are limited to 3 per cent of the total weight.

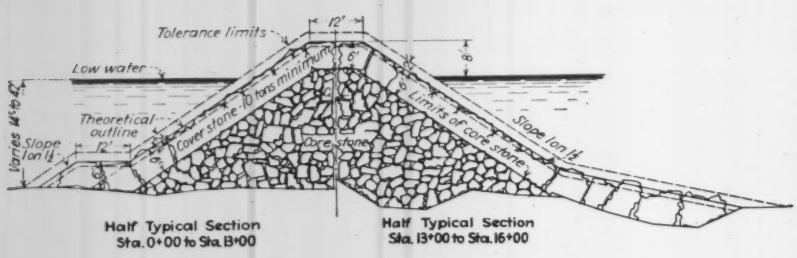


Fig. 2. Design of the Marquette breakwater calls for a cover of 6-ft. stones, 10 tons minimum weight, over a core of quarry-run rock.

At the outer end of the new breakwater a 30x30-ft. timber crib 17 ft. high was sunk as a base for a lighthouse. The crib rests on a prepared bed of high-density stone (iron ore) and is filled with the same material. Base and fill required 1,077 tons of ore. On top of the crib will be built a cellular concrete structure 16 ft. high upon which the lighthouse superstructure will rest. The crib is of standard design, consisting of solid walls of 12x12-in. timbers dovetailed at the corners, and three timber cross-walls in both directions. In one direction the cross-walls are dapped and dovetailed into the end-walls; in the other direction they are only dapped and dowelled.

Quarry operations

Stone production is the key to this job. Not far from the L. S. & I. R.R., about 3 miles out of town, an outcrop of suitable rock was found that could be developed into a quarry face from 80 to 100 ft. high. The rock is a peridotite, weighing 182 lb. per cu. ft., hard, dense, and filled with quartz and other intrusions, but having few seams or planes of cleavage. As is always the case in quarry rock having these characteristics, most of the stones break out in odd and queer shapes, and even though the pieces can be roughly trimmed, there is difficulty at times in meeting the requirements of placing the stone in close contact in building the breakwater. Yet, despite the characteristic roughness of the individual pieces, a satisfactory smooth outline of breakwater is being obtained.

To develop the quarry, the talus slope was broken down and spread out for a working floor and railroad yards. A bulldozer aided in leveling off the quarry area, and is now used to get rid of waste material.

Four coyote-hole shots, one of which was largely to remove talus material, brought down an estimated 350,000 tons of rock, probably enough to complete the job unless the waste runs higher than it is at present. From 10 to 14 tons of dynamite was placed for each shot in cross drifts driven from tunnels that extended into the base for 100 ft. or so. The coyote holes were driven by tunnel methods with wet drifter drills mounted on columns; mucking out was by wheelbarrow.

The shots lifted the face of the quarry without undue scattering of the rock, though some of the individual pieces broken out weigh up to 100 tons. These, of course, are reduced to handling size. The large stones as handled average 15 or 16 tons each, but a few pieces as large as 38 tons have been loaded, transported and placed, an indication of the size of equipment being used.

Two gas crawler shovels of 1½ and 1¾ yd.-capacity are used for removal of waste material and loading of the smaller core stone. These

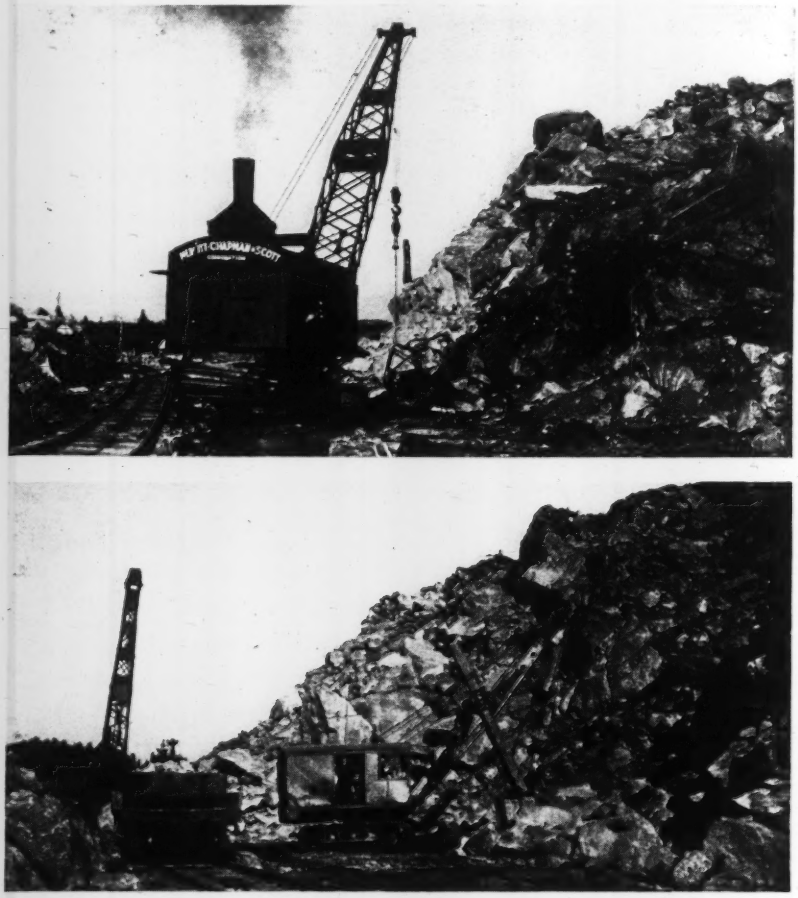


Fig. 3. At the quarry, a faithful old steamer, (top) her tail weighted with car axles, sorts out the large stones in advance of a smaller shovel (below) loading the quarry-run core material into skips on flat cars.

rigs are equipped with fairleads, and a dragging line is frequently used to pull down large pieces hung up on the quarry face. The fine core material is loaded into 6-ton steel skips set on flat cars.

A large steam crawler crane, counterweighted with railroad car axles, (Fig. 3) and a heavy locomotive crane fitted with special home-made but very effective outriggers, load the large stone on flat cars. Threatened destruction of the wooden car decks was averted by spiking longitudinal

rails, 2 ft. c. to c., to the decks. Another indication of the extent of quarrying operations is the fact that 82 standard flat cars are in constant service, and frequently four or more trainloads are moved daily from quarry to unloading dock. Two gas locomotives do the quarry switching. The big stones are loaded by means of ingenious basket slings consisting of a chain loop carried by wire rope slings (Fig. 4). Two men are kept busy making up slings from discarded hoist cable from nearby iron mines. After the stones are loaded onto the cars they are drilled for lifting holes and are squared up as much as possible by removal of fins and projections with an air hammer. Both of these operations are done on the car rather than on the ground, for the projections aid in holding the loading slings, and the lifting holes can be drilled in correct position for unloading at the dock. Despite the trimming up, the stones often come to the job in queer shapes.

Because there is no storage space for stone other than at the quarry, and even here it is limited, the working over of the material to discard the waste and to follow the desired loading schedule becomes a key operation. Sometimes the working of the face produces a run of large stone, which must be broken down to handling size and set off to one side for future loading. Again it is a run of waste and small stuff to be handled. At best, considerable rehandling of material is inevitable.

Pieces too large for handling are broken up by block hole shooting and by plug-and-feathers. There is a crew always at work breaking up, using dry jackhammer drills. However, every driller and helper wears a dustproof respirator for prevention of silicosis, and every man exposed to quarry rock dust is X-ray examined prior to employment. The number of applicants found unfit for work by such examination is negligible.

Other drilling operations include those for light shots to bring down material hung up on the face slope, and wagon drill work for removal of talus slopes. Two single-stage 12x14-in. compressors, electrically driven, furnish all air required. A 4-in. electric pump supplies cooling water for the compressors and water for the quarry equipment. Compressors and pump are located at the shore of Dead River about 500 yd. away.

All drilling is done with detachable bits, and though the rock is extremely hard, the average depth of hole per sharpening is 8 in. Bits are reground three times on the job, then are sent out for rehardening and regrinding, after which they are good for one more regrinding.

Stone placing

From the quarry the loaded cars are taken by the L. S. & I. R.R. to its dock near the head of the breakwater. Here the contractor has laid out a series of storage and unloading tracks. Floating plant for handling and placement of the stone includes a heavy steam whirley crane mounted on a steel barge; a large floating steam derrick that also carries a considerable deck load; a steel hopper dump barge of 800 tons capacity for core stone; two deck scows; and one large steam tug for moving the plant. The two floating cranes at work are shown in Fig. 5.

Much of the stone for a day's run is transferred at night by the floating rigs, assisted by a large locomotive crane on the dock. This crane does the necessary day-time unloading when the two floating cranes are out on the breakwater.

The finer core material comes to the dock in the steel skips, which are unloaded into the dump barge, though some loaded skips are taken out on deck for filling and leveling purposes. The heavy core stone and all the cover stone is transferred direct from cars to decks, as there is no ground storage space at the dock (Fig. 6).

The first move in stone setting is to place the heavy toe pieces, specified to consist of "the largest size furnished by the contractor." These are set first so as to retain the base of the core. On level bottom the setting of the first stones is easy, but much of this bottom is sloping, which means the stones must be shifted around on the slope until they come to a firm position. After a stretch of toe stones has been placed on both sides, dumping of the core proceeds. Material handled through the dump scow includes both the finer stone that is transported from quarry to dock in skips, and the larger core stones loaded into the scow as individual pieces. The draft of the dump barge permits dumping only to an elevation 12 ft. below water surface, though occasionally the scow is lightly loaded to dump to a higher level. Consequently, the upper part of the core is placed by transferring the loaded skips from the cars to deck scows and dumping them in place with the floating derricks. The larger core stones are handled piece by piece. Cover stones are placed on the core as fast as it is built up to hold the smaller material in place.

Fig. 4. A locomotive crane loads the heavy cover stone, up to 38 tons each, onto the cars by means of an ingenious chain and wire rope basket sling.

Setting of the cover stone is exacting work; expeditious setting depends largely upon the efficiency of the crews. The large pieces are handled by a two-point chain hook, the points

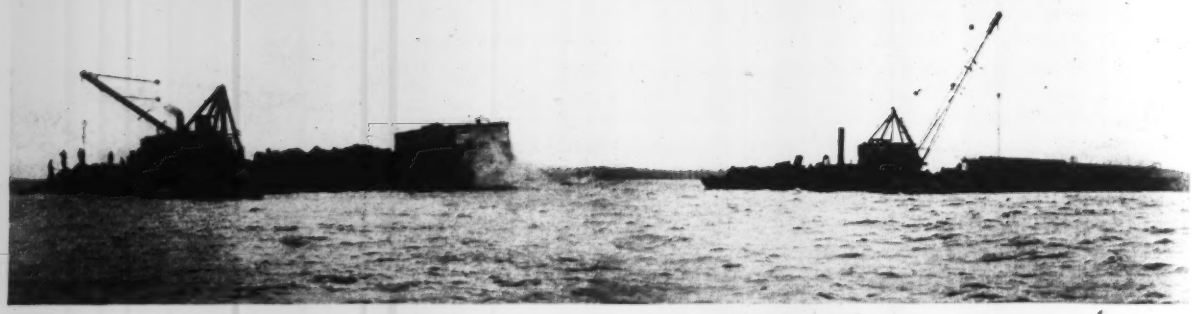


Fig. 5. These are the large floating rigs that build the breakwater. At the left is a stiffleg lighter that carries a large deck load; the right view is a large whirley derrick mounted on a steel barge; both rigs have independent anchor engines.

Fig. 6. The stone gets both a land and water haul on its way to the breakwater. Above is a string of flat cars loaded with cover stone. Note the driller, equipped with dust mask, trimming off the rough spots on a stone already loaded. Below is a loaded deck scow ready for a trip to the job. Ernest Seemann, job manager, is standing alongside a big one.

engaging the lifting holes drilled at the quarry. These stones must be placed "as close as the shape of the pieces permit." Many pieces are lifted, turned and shifted several times before they are placed finally in a position that meets the specifications. Sometimes a stone is returned to the deck for some future position after juggling around without success in fitting. The cover is a gigantic jigsaw puzzle without the benefit of a picture pattern as a guide.

The cover may be placed within a tolerance of 3 ft., that is, between 1 ft. below theoretical outline and 2 ft. above. Effort is made to work to the upper limit line, for this allows more leeway in the selection and placing of individual pieces. Skipfulls of fine stone are always available for filling in exceptional voids and for providing a cushion for odd-shaped pieces.

The building, sinking and filling of the timber crib were carried out without difficulty under ideal weather conditions. Iron ore was dumped for the crib base and levelled off to grade with the aid of a diver. The crib was fabricated near shore and towed to place.

The entire job is worked three shifts a day, six days a week, though no stone is placed in the breakwater at night. A maximum crew of 200 men was used during the summer, but operations were tapered off during the fall and were shutdown about the middle of November. On many occasions the floating plant has been forced to shelter by high winds and waves, losing many days in placing.

The project is under the direction of Lt.-Col. X. H. Price, district engineer, Duluth, Minn. J. E. Schradle was resident engineer until Oct. 7, when he was succeeded by V. G. Erickson.

The job is being handled out of the New York office of the Merritt-Chapman & Scott Corp. as a subcontract for the Polaris Concrete Products Co., Duluth, Minn., Gorden H. Butler, president. E. A. Banister, vice-president, and Ernest W. Seemann, project manager, are in charge for the subcontractors. E. L. Olsen is general superintendent, and Ernest Hudson is in charge of the quarry.

Iran Builds a Railroad

Ancient Persia finishes its project from the Caspian Sea to the Persian Gulf

A FORTY-FIVE-YEAR dream of railroad construction across Iran (Persia) from the Caspian Sea to the Persian Gulf of the Indian Ocean was realized in August when the first train traversed the 865 miles from Bandar Shapur on the Gulf to Bandar Shah on the inland sea.

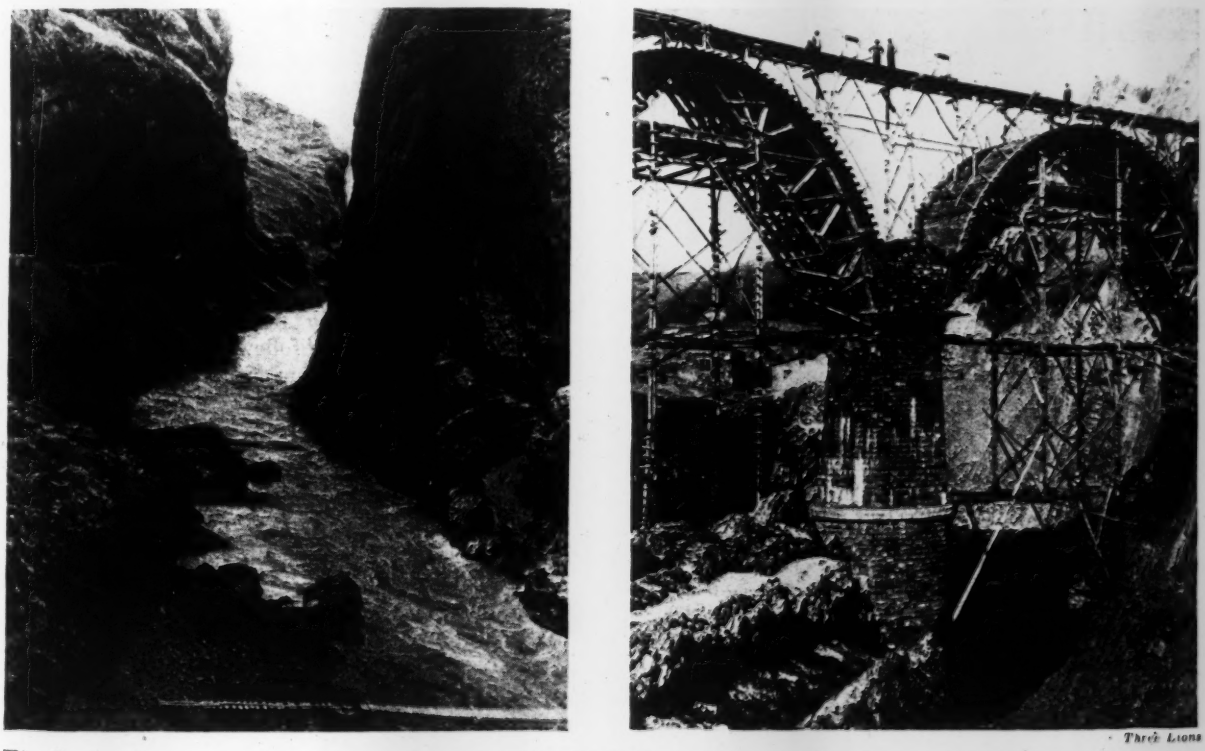
Since the nineties, Iran's rulers had been playing with the idea of such a road, but it was only in the last decade that any action was taken. In 1926, planning was done in a small way and some construction was begun the next year. The illustrations give an idea of the type of country through which the road is routed. About 250 tunnels were built, including one of 1¼-mi. length. In the section of road through the pass illustrated by Fig. 1 (left), it was necessary first to cut a narrow service road in the cliff wall, as shown. Grades on the line are as steep as 3 per cent. Workers, mostly Persian, numbered 50,000 at the peak of construction.

Home financing

Financed entirely by proceeds from Iranian tea and sugar taxes, the railroad cost about $140,000,000. Since 1933, Kampsax Consortium (Kampmann, Kierulff and Saxild), a Danish syndicate, has been in charge of engineering. The earlier work was done by an American and a German group (*ENR* Oct. 25, 1934, p. 527).

Fig. 2. Map showing location of the Trans-Iranian Ry.

Next step in Iranian Railway development is to be a line from Teheran, the capital, to Tabriz, where it will connect with the Soviet system.



Three Lions

Fig. 1. (Left) Trans-Iranian Ry. trains are now rolling through this gorge where at the time this view was taken there was no construction but a narrow service road carved in the left wall. Note the suspension footbridge in the foreground. The rugged nature of much of the country necessitated construction of many bridges such as the one above which consists of two 130-ft. spans 100-ft. above the Ab-i-Cesar River. Note the use of windlasses and rough native scaffolding. Sawed form timbers for centering the masonry arches was brought from England at a cost of $10,000.

Selling Public Works to the Public*

E. J. CLEARY
Assistant Editor, Engineering News-Record

Don't blame the taxpayer for lack of support when you fail to keep him informed and interested in the job he hired you to do

RECENTLY a group of municipal public works administrators were discussing their problems, and their comments were frequently interjected with such remarks as "There is a lack of citizen support"; "People have no idea what we are trying to do"; and "Everything is taken for granted until something goes wrong." After a half hour of this, it was easy to see what they considered to be at the root of many of their difficulties—an unappreciative, unresponsive public. But in response to the suggestion that a solution might be found in a program of public relations, they chorused in amazement, "Do you mean that we must sell ourselves and the work we are doing to the people who hire us?"

And why not? Despite the fact that public works and services intimately affect the welfare of every citizen, most of them are unaware of what is being done or how. And it follows that if no effort is made to encourage active interest in these matters, the public will continue to be apathetic. To realize the full objectives of any program, a definite campaign must be undertaken to awaken interest and sustain it. Somehow this concept is seldom carried over to municipal public works endeavor.

It is true that the technical planning and operation of public works facilities is the responsibility of the administrator, but the size of the budget with which he has to work, and the money voted to execute improvements depend in large measure on the attitude of the public. All too frequently this attitude reflects misunderstanding, ignorance or prejudice. And these often have their basis in the failure to provide adequate information and the lack of effort in promoting sympathetic understanding, in other words, public relations have been ignored.

It may be argued that there are no precedents on which to base a complete campaign. However, a number of helpful hints suggest themselves from which a course of action, suited to local conditions, might be formulated. In general, all of these efforts are directed towards "educating" the public. And while it is appreciated that people don't want to be educated, there are ways in which the process can be carried out in a subtle, painless fashion.

One of a series of articles devoted to the proposition that upon the development of better public and employee relations rests the future welfare of the construction industry.

Perhaps the most effective means of acquainting the public with what is being done and why is through the local newspapers. Everything which affects the welfare of the people—and public works activities certainly do—is legitimate news. And it should be remembered that editors never neglect to provide reporters with regular assignments to cover "city hall."

Here is an opportunity which can be capitalized. Cordial relations can be established with the representatives of the press by assuring them cooperation in obtaining information. To save time and also insure impartiality in the distribution of news, it might even be desirable to inaugurate regular press conference periods. This gives an opportunity not only to furnish material for immediate release but also to talk "off the record" and indicate future developments which may eventually become "news."

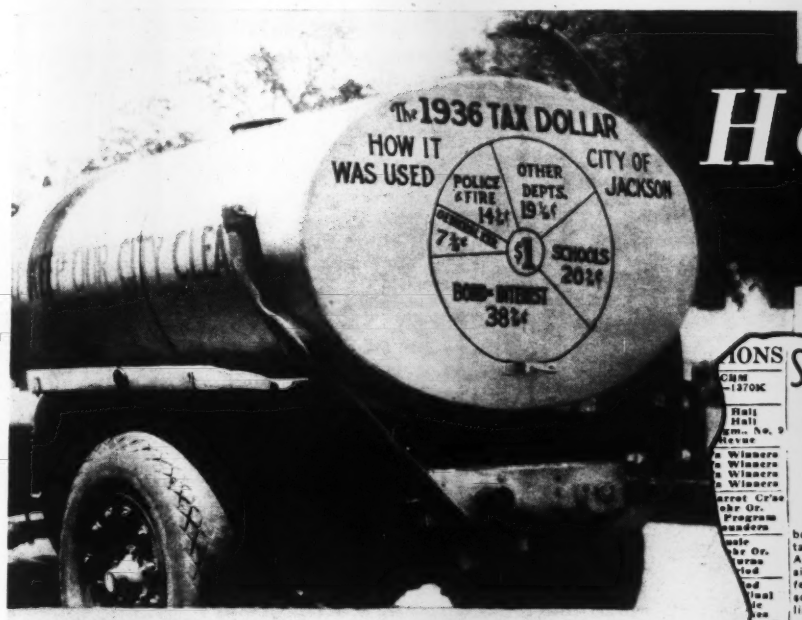
At times when news is scarce or when feature treatment is desirable for a particular subject, there are numerous matters which might be suggested to the city hall reporter for attention. Publication of articles of general information value may be used very constructively. As an example: An administrator of a small town who had installed traffic control lights was soon plagued by citizen groups with requests for additional lights here, there and everywhere. Examination revealed, in almost every instance, that there was no pressing need for the lights. Being a tactful man, the administrator did not flatly turn down the requests but said he would give them careful study.

Soon thereafter a feature story appeared in the local paper; it described how the new traffic lights were operated, and then went on, incidentally, to stress the point that each installation cost $500. More lights would be added, the story said, as soon as the new budget was prepared and adjustments were made for increased tax rates to meet the cost. "Funny thing," said the administrator, "following that story I seldom heard any more about additional lights."

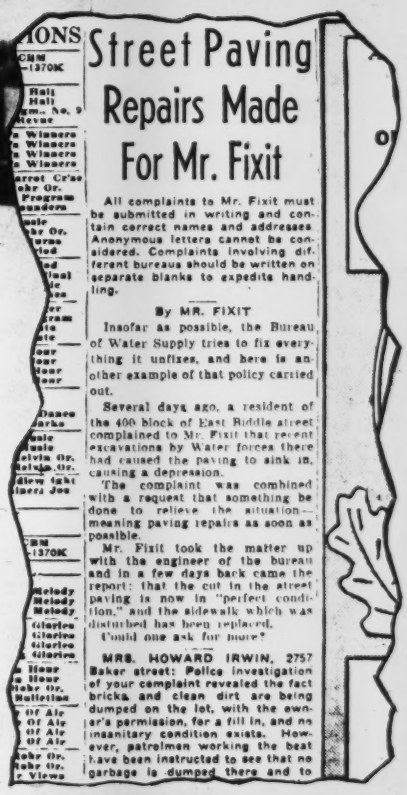
This is a good illustration of how one administrator, with the aid of his local newspaper, educated the public to understand his problem, and what is more, he lost no friends in so doing.

There is no end, of course, to the number of newsworthy, informative items which can and should be brought to public notice through the medium of the press. Once a year, however, and possibly oftener when special needs arise, a more comprehensive report of stewardship is in order. This is not to be confused with the "annual report," so-called, required by law in, most places

How To Do It



Citizens in Jackson, Miss., get a daily reminder of how their tax dollar is spent. Use of rolling equipment to carry messages of public interest is cheap and effective.



Street Paving Repairs Made For Mr. Fixit

All complaints to Mr. Fixit must be submitted in writing and contain correct names and addresses. Anonymous letters cannot be considered. Complaints involving different bureaus should be written on separate blanks to expedite handling.

By MR. FIXIT

Insofar as possible, the Bureau of Water Supply tries to fix everything it unfixes, and here is another example of that policy carried out.

Several days ago, a resident of the 400 block of East Biddle street complained to Mr. Fixit that recent excavations by Water forces there had caused the paving to sink in, causing a depression.

The complaint was combined with a request that something be done to relieve the situation—meaning paving repairs as soon as possible.

Mr. Fixit took the matter up with the engineer of the bureau and in a few days back came the report: that the cut in the street paving is now in "perfect condition," and the sidewalk which was disturbed has been replaced.

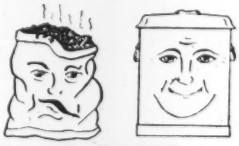
Could one ask for more?

MRS. HOWARD IRWIN, 2757 Baker street: Police investigation of your complaint revealed the fact bricks and clean dirt are being dumped on the lot, with the owner's permission, for a fill in, and no insanitary condition exists. However, patrolmen working the beat have been instructed to see that no garbage is dumped there and to

An example of how an alert newspaper aids municipal public relations.

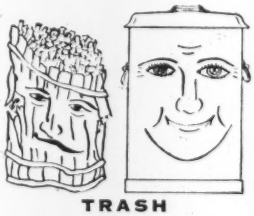
Courtesy Baltimore News Post.

Hang this in your kitchen please, and read what's on the card,
And it will help you to improve, conditions in your yard.



GARBAGE

Please have a metal garbage can,
The top let's not ignore,
In gallons of not less than three,
Nor more than twenty-four.
And do not mix your garbage with
The trash, please keep this fixed,
Because our men are not allowed
To move it when its mixed.



TRASH

All other refuse, ashes, trash,
Or brush that you cut down,
Goes in your trash container, and
Not ever on the ground.
Trash cans should be in gallons of
Not more than twenty-four,
Repair debris, we don't collect,
Please heed this, we implore.

PLACE FOR CONTAINERS

Please place the cans at your back gate,
When taken from the rear,
Our men will gladly dump your cans,
Each week throughout the year.
If cans are taken from the street,
Place them at front or side,
And service will be furnished you,
Wherever you reside.

For further information call, Two-Seven-Two-O-One,
And D. P. W. Streets Bureau, will answer on the run.

Department of Public Works, - Richmond, Va.

Richmond says that this is the "ticket". A message from the Department of Public Works which has won friends.

Public interest is stimulated in new construction at Radio City by the "Sidewalk Superintendents' Club". Favorable attention to public works projects may be created in like manner.

which usually is a stiff, formalized statement weighed down with drab statistics. There is only one place for such reports—on the auditor's desk.

To prepare a report of stewardship, which will invite attention and be read, is no ordinary job. Among other things, it calls for considerable revamping of the time-honored opener, "Herewith is presented a summary of the year's operations, etc., etc.," which dares a reader to continue with the factual recital that follows. Once this is discarded and imagination is given some free rein, something constructive can be done. A little study of the promotional literature and advertising used by alert business concerns will furnish some helpful ideas on makeup and style of presentation.

By all means study a copy of "San Diego Affairs," that cleverly illustrated, concisely phrased, yearly report published by City Manager Flack. Here is a splendid example of what one administrator achieved in his effort to make a municipal report readable. Skilfully employing typography and pictorial representation plus effective "copy," Mr. Flack gets the attention of the reader and leaves him with some definite impressions of what has been done and what needs to be done in the way of further improvements.

Another well-designed and interesting report on municipal affairs which departs from formula-presentation is "New York Advancing," a story which brings to the citizen a dramatic recital of the problems encountered and the methods used in operating a city of 7,000,000 population. That a small city with limited resources can likewise do an effective job in reporting is exemplified in the mimeographed pamphlet gotten out each year by Clarence Arrasmith, city manager of Fillmore, Calif. (pop. about 3,000). Proudly titled "Telling the World about Municipal Doings at Fillmore," it is a chatty, human document of problems and progress in the life of a growing community.

A few cities, of which Toledo is a good example, employ a monthly bulletin to bring matters of special public concern before the citizen. At Toledo the preparation of the bulletin is handled by the Commission of Publicity and Efficiency which is the research agency for the city government. Recently, articles in this bulletin along with a special report distributed from house to house was effectively used to bring before the people the need for a new water supply system, construction of which depended on approval of a bond issue. That Toledo citizens have been in no mood for voting bond issues is revealed by the record over the last eight or nine years in which every proposed issue was turned down. But they approved the bond issue for water supply improvements, by a vote of 9 to 1.

> Technical planning and operation of municipal public works facilities is the responsibility of the administrator. But the size of his budget and the money voted to execute improvements depend on the attitude of the public. All too frequently this attitude reflects misunderstanding, ignorance or prejudice. A program of public relations, therefore, should not be ignored.

Motion pictures and the radio

The written word, however, is not the only means for making the public public-works-conscious. Not to be overlooked is the almost universal appeal of motion pictures. And with the availability of low-priced equipment for taking and projecting these pictures a splendid opportunity exists to capitalize on this entertaining method of "educating" people. Schools, church groups, civic associations, and other organizations are usually eager to have local-interest films as a feature spot for their meetings.

A typical municipal subject on which a picture could be based might be street cleaning. This could show how the job is done in various sections of the city, why certain types of equipment are used, and the economy of present day methods over the old. If one of the problems is cleaning streets where cars are parked, an opportunity presents itself to show exactly how the parked car hinders the work of the department and raises costs.

All types of municipal activity might thus be photographed. And particularly interesting, because everyone is a construction engineer at heart, will be a progress picture on the building of the new water treatment plant, the new bridge, or any of the numerous improvement projects which are undertaken by the municipality.

In Sewickley, Pa., borough manager John C. Hiteshaw is reported to be successfully using movie-reporting to acquaint the citizens with the details of municipal work and specific local problems. He purchased used equipment for this purpose, costing about $100, and thus far has produced pictures on zoning, the waterworks system and needed street improvements. Mr. Hiteshaw has even gone so far as to prepare a film showing sewage disposal works in other towns so that the people might be better informed regarding a proposed treatment plant for Sewickley. The films are loaned upon request and they are then to be filed as a permanent record of town affairs.

The radio, too, might be enlisted as a means of acquainting the public with what's what and who's who in the public works department. Jacksonville, Fla., recently found that a radio appeal for citizen cooperation in keeping streets clean produced highly beneficial results. The city used the local station, and in broadcasts, spaced a week apart, gave three operating men in the street department an opportunity to tell of their problems and to suggest means by which citizens could help the men working for them to keep the city clean.

In order to do a better job in snow clearing, E. A. Miller, supervisor of maintenance, Rochester, N. Y., uses the radio during storm periods to call upon people to remove parked cars from the streets. The response to such appeals, he reports, is a tribute to citizen cooperation and greatly facilitates the work of the department.

Slogans and messages

Every city has matters that it would like to impress on the minds of its citizens such as a reminder that taxes are due. A favorite and effective way of publicizing this is to print or stamp a slogan on the envelope containing the tax bill. Enve-

lopes and stationery can be similarly marked to carry other messages to the citizens of the municipality.

Messages that travel

This idea is not limited to mailing pieces, however. In some places the automotive equipment, such as refuse collection vehicles, street flushers, etc., which daily pass the citizen are used to carry a slogan. Jackson, Miss., for instance, uses the cylindrical tanks on its street flushers to carry a "pie" type diagram which informs the citizen how and where his tax dollar is spent.

In New York the Department of Sanitation is waging a campaign on sidewalk cleanliness, and to bring this constantly before the public the refuse collection trucks carry the cryptic but meaningful message, "Clean Your Sidewalks, Curb Your Dog."

One city has been so impressed with results achieved through messages painted on the trucks that it has now provided a special display spot on each vehicle where regular series of civic "advertisements" are carried.

Open house program

Another scheme for selling the citizens on what the city offers is the yearly municipal "open house" or exposition. Berkeley, Calif., and Toledo, Ohio, conduct such promotional affairs and find the public interested in attending them.

A building with lots of floor space, such as an armory, is ideally adapted for the open house show. Various departments can then put on a display of equipment used in carrying on their work, and models can be shown of the waterworks, the disposal plant or the incinerator. In conjunction with the exhibit, an essay contest for high school students on various phases of city works operation might be staged. Awarding of prizes to the winners on the exhibit floor helps to create interest and swell the attendance.

In this sketchy outline, a number of ways of promoting citizen interest have been enumerated. All of them have merit, and in the aggregate they represent the basic essentials of a program of public relations designed to inform people as well as to awaken their interest and support in the job you do.

Hydraulic Jump In Trapezoidal Channels

C. J. Posey and P. S. Hsing

Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City

Formulas developed provide information useful in preliminary design and selection of economic side slope

Studies on the use of hydraulic jump to dissipate energy and to prevent scour, made by the Miami Conservancy district in 1915, showed that this device provided an economical and trouble-free safeguard against dangerous erosion. The jump has subsequently assumed increasing importance, and it has become necessary to know not only the relation between water velocities and depths, but also the length of the jump. Considerable economies might be effected if the behavior of the jump could be predicted in channels of trapezoidal cross-section commonly used for canals. In the past designers have been wary of using non-rectangular channels, mainly because of the lack of experimental data on the jump in those channels.

The theory of the hydraulic jump in rectangular channels, first published by Belanger in 1838, is based on the principle of conservation of linear momentum. Experiments by Gibson and others have shown that Belanger's theory gives the correct relation between velocities and depths before and after the jump. Excepting recent experiments by Lane and Kindsvater on channels of circular cross-section, and possibly other unrecorded studies, all previous experiments have been made in rectangular channels.

Scope of tests

The tests herein described were run in trapezoidal channels with side slopes of 1:2, 1:1 and 2:1. The bottom widths were 1.250, 0.551, and 0.235 ft., respectively. All channels were 20 ft. long and were constructed of wood lined with waterproofed Masonite, in a 32-ft. flume. Depths before the jump varied from 0.033 to 0.372 ft., and depths after the jump from 0.163 to 0.852 ft. More than 200 test runs were made. Observations were made on longitudinal profiles, cross-sections, velocity distributions, and other phenomena. Manning's coefficient of roughness for the channel was 0.010.

The observed height of the jump was found to agree with that computed according to the law of momentum. During analysis of the data, it was necessary to make many computations of theoretical depths before

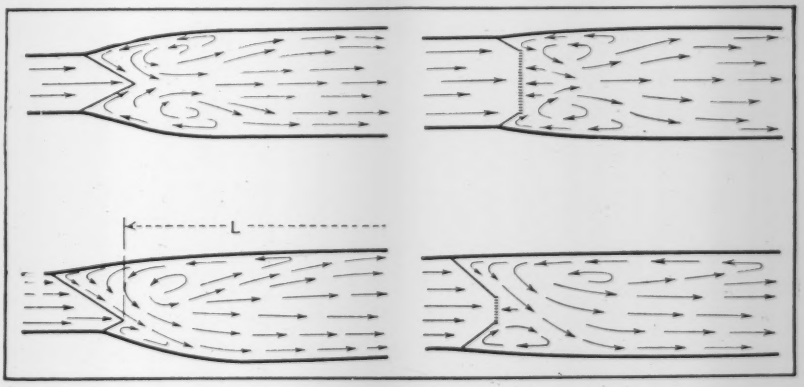


Fig. 1. Plan view of different forms of the hydraulic jump in trapezoidal channels, showing the direction of surface currents.

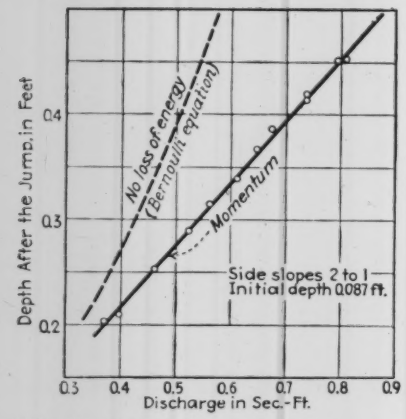


Fig. 2. Typical comparison of observed and computed values of depth after jump.

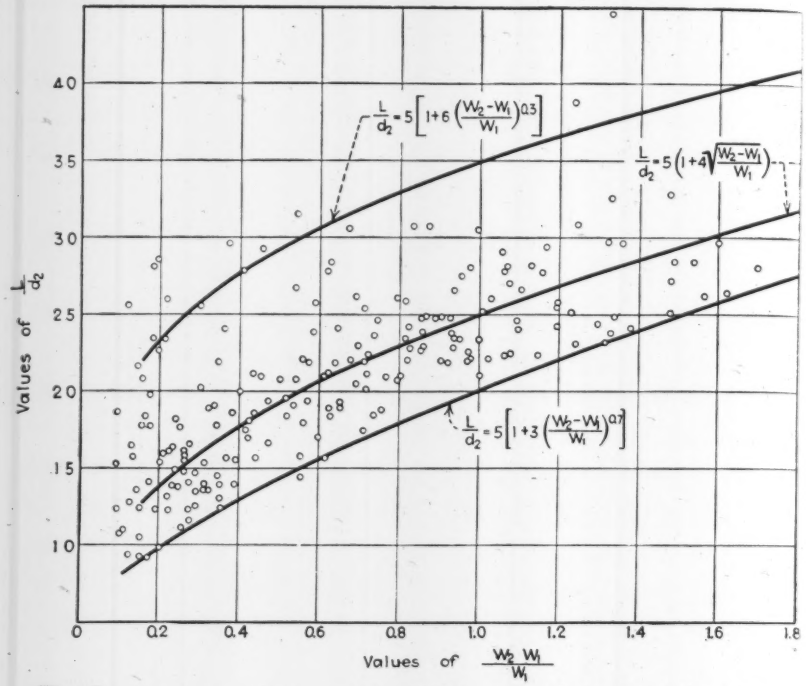


Fig. 3. Comparison of observed data and formulas for length of the jump.

and after the jump. In cases where a large number of depths in a certain channel were to be computed, it was found worthwhile to construct a graph or nomographic chart giving the values directly; for a moderate number of computations, however, the method of balancing the pressure-plus-momentum equation by trial and error was preferable.

Differences noted

In appearance, the jump in a trapezoidal channel differs from the jump in a rectangular channel in that wedge-shaped wings form on each side. The wings may meet, or be joined by a straight portion similar to the toe of the jump in a rectangular channel. The water surface in the high velocity sheet before the jump was smooth and level in all tests, but in the jump the surface was not level transversely, the wings being higher in the upstream portion. In many of the tests alternate ridges and troughs formed in the downstream portion before the full height was reached.

Wing angles

In the channels tested the inside edges of the wings formed angles of approximately 23, 26, and 18 deg. with the flume axis, the smaller angles corresponding with the flatter side slopes. One of the wings was likely to be longer than the other, but this dissymmetry seems to have been due to inherent instability rather than lack of symmetry in the set-up, as the longer wing could exist for a time on either side.

The length of the jump in a trapezoidal channel is less definite than in a rectangular channel, and for flat side slopes is considerably greater. Nearly all of the lengths measured fell within the extremes given by the formulas:

$$\frac{L}{d_2} = 5\left[1 + 3\left(\frac{W_2 - W_1}{W_1}\right)^{0.7}\right]$$

and

$$\frac{L}{d_2} = 5\left[1 + 6\left(\frac{W_2 - W_1}{W_1}\right)^{0.3}\right]$$

where:

L is the length of the jump which is measured along the centerline of the channel.

d_2 is the depth after the jump.

W_1 and W_2 are the widths of the water surface before and after the jump, respectively.

The best average values were given by the formula:

$$\frac{L}{d_2} = 5\left(1 + 4\sqrt{\frac{W_2 - W_1}{W_1}}\right)$$

These formulas should provide the necessary information for preliminary design and selection of economic side slope. The authors believe, however, that the length of the jump cannot be accurately predicted from the results of small-scale experiments, so that large-scale tests would be advisable before construction of any important work was undertaken.

The length of the jump is a function of the depths before and after the jump, the shape of the channel, the roughness of the bottom and sides, the viscosity and surface tension of the liquid, and other factors. Of all these, the first three only are considered in the above formulas, and they are lumped together, for simplicity, in terms of d_2 and the widths before and after the jump. When W_2 equals W_1 the formulas give $L = 5d_2$, which agrees fairly well with published values for the jump in rectangular channels if d_1 is small in comparison to d_2. The effect of d_1, which may seem to be omitted in the formulas, is included implicitly.

Acknowledgment

This article is in part a condensation of a thesis submitted by the junior author to the State University of Iowa in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Special acknowledgement is due Professors Edward Soucek, E. W. Lane, and F. T. Mavis for valued advice and assistance in various phases of the channel investigation.

Zoning and its Widespread Evasion As Found in Chicago

CITY ZONING, like many other factors in municipal development, depends largely for its success upon proper action by the officials concerned with its enforcement. That zoning in Chicago has served a useful purpose, but has fallen far short of fully accomplishing its purpose, is the opinion expressed in a recent report of the Metropolitan Housing Council of Chicago. This report presents the expected and actual results of the zoning ordinance, passed in April, 1923, and both these aspects of the report are summarized below:

Anticipated Results

It was believed that division of the city into building zones would stabilise real estate values by preventing the scattering and intrusion of inappropriate uses of buildings, and would provide districts in which industries might locate without fear of complaints from property owners. Peace and quiet would be enhanced in residential areas, while building line restrictions would allow future widening of streets at a minimum of expense. Public health should benefit from quieter residential districts, decreased congestion and better light and air. Fire hazards would be reduced by limiting the heights and density of buildings.

The weaknesses of the present system as outlined in the report are of three classes: (1) improper districting, (2) loopholes and inadequacies in the ordinance, (3) laxity in administration. As instances of unsatisfactory distribution of zones, it is noted that in 1923 the ordinance zoned less than six square miles for residence use, although 23 sq. miles were already in use for that purpose. More than 64 sq. miles were zoned for two-family and multiple-family buildings, although the areas actually used for such buildings amounted to less than 25 sq. miles. Land zoned for commercial use was nearly three times as much as was then devoted to such use, while areas of excessive size were zoned for manufacturing. Redistricting, based on a thorough study of the situations, is stated to be a prerequisite to good zoning.

As to the text or wording of the zoning ordinance, experience shows the need of many changes. For instance, certain auxiliary uses are not clearly defined, so that large numbers of beauty shops and similar enterprises have been established in residence sections and are a frequent source of complaint from property owners. Again, a number of light manufacturing uses are permitted in commercial districts adjacent to apartment or residence districts, but many of these uses have proved offensive to residents.

An objectionable feature of present practice is the continual granting of amendments to the ordinance. From 1923 to the end of 1937 the amendments numbered 868, mainly for rezoning, and many of these were made solely to give special privileges to individuals. In some cases when amendments have been refused by the officials they have been granted by the City Council without regard to their legality or their effect on the public welfare. In one such case, a court held that the council's action was arbitrary and unreasonable, with no consideration for property values or the direction of building development to the best advantage of the city.

Analysis of the amendments indicates that, as might be hoped, areas zoned for residence use are increasing, while those for apartment and manufacturing use are decreasing. But unfortunately the greatest change has been in areas for commercial purposes, since (as already explained) the city is seriously overzoned for such use. While only 28,000 ft. of frontage have been changed to a more restrictive volume district, no less than 1,300,000 ft. have been changed to less restrictive volume, which means opening the way to greater lot coverage and crowding, with their attendant evils.

A different class of amendments, termed "variations," permit a particular building to have a use or extension of volume in an area from which it would properly be excluded. One of the most serious failures in the ordinance and its administration is the permission of large numbers of such exceptions, thus tending to undermine the zoning system. There have been more than 2,000 variations.

As to violations of the ordinance, these exist in great numbers, and it is a frequent complaint of civic groups that their reports of violations are unheeded by the enforcing authorities. When a commercial use is permitted to become established in a residential area, the neighborhood is injured and the legitimate owner of commercial property on a street zoned for such use is subjected to unfair competition. One reason for many violations is that the commissioner of buildings does not require certificates of occupancy, although the ordinance specifically charges him with this duty.

Recommendations

As effective development of the city will depend largely upon the zoning ordinance and its administration or enforcement, certain definite recommendations are made by the Metropolitan Housing Council: (1) review of the text of the ordinance and adoption of necessary revisions by the City Council, in cooperation with zoning experts, architects, engineers, real estate men, builders and others; (2) the commissioner of buildings should require certificates of occupancy as a regular procedure (as required by the ordinance) and should adopt other measures necessary for adequate enforcement of the ordinance; (3) the city council committee on buildings and zoning should state specifically the reasons for and desirability of each proposed amendment in its relation to building development and the public welfare; (4) in recommending "variations," the zoning board of appeals should state specifically the nature of the difficulties or reasons which justify such recommendation; (5) all proposed amendments should be submitted to the Chicago Plan Commission for consideration, and closer cooperation should be maintained between this commission and the board of appeals.

Why Concrete Pavements Curl

CLARAN F. GALLOWAY
Los Angeles County Road Department, Los Angeles, Calif.

Periodic tests by profilometer indicate that curl in pavement slabs is due chiefly to moisture-content differential between top and bottom

A STUDY of surface graphs of concrete pavements made by the Los Angeles county road department indicates clearly that roughness is a fluctuating condition. Roughness varies depending on precipitation, character of subsoil, season and age. Under these influences the surface profile of the concrete slab is constantly changing. The movement too is entirely within the slab; it is not caused by external force as for example swelling of the subgrade soil. Altogether, the phenomena disclosed by the graphs indicate changes in design practice that promise reduction of roughness.

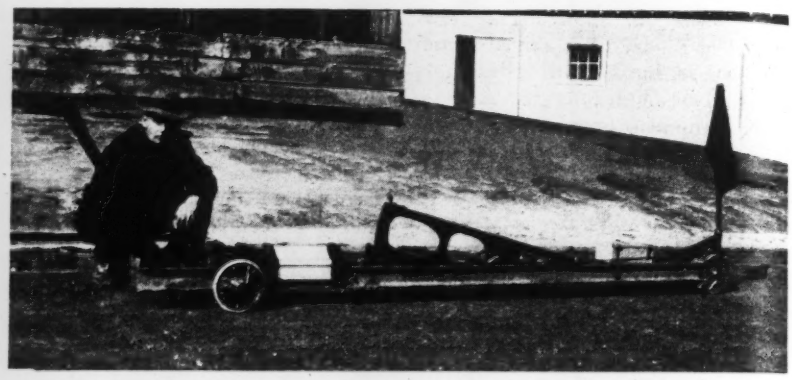


Fig. 1. A roughness meter gives vital new information on pavement curl.

How graphs are made

One graph is made for each day's pour during construction for the guidance of the project engineer and the first graph for the records is made from one week to one month afterward. Succeeding records are made at intervals of about two weeks as indicated by Fig. 2. Fig. 1 shows the recording device. It consists of a rigid frame with fixed wheels at the ends and at the center a wheel that is free to move perpendicularly with respect to the frame. As the center wheel passes over a high or low spot in the surface it rises or falls and moves a pin transversely to the travel of recording paper which passes under it at a specified rate per lineal foot of surface traversed. The resulting record Fig. 2 is a surface graph.

With the progress of graph taking it was observed that graphs taken during construction generally showed a quite smooth pavement, the average rating being less than five, but on 13 tests used as a basis for this discussion, one week to one month after construction, the records showed an average rating of 44.5.

Individual sections of pavement had a variation in deflections depending on the season in which the record was made. If there had been considerable precipitation just preceding the record, the rating determined from the resulting graph was better than if the record had been preceded by a long dry period.

Also, it was noticed that pavements laid over soils of high capillarity or soils which retained moisture throughout the year had, comparatively, a large variation in rating from wet to dry season. If the record had been preceded by prolonged dry weather the graph showed an increase in the magnitude of the individual deflections. Those pavements laid over soils of low capillarity which tended to drain and dry out rapidly had the least variation in rating from wet to dry season.

In addition, it was noticed that after a time, usually between six and twelve months after the first graph was made, transverse cracks began to appear in the pavement slabs accompanied by a reduction in the magnitude of individual deflections which affected a reduction in the ratings.

An examination of the graphs reveal that most of the deflections and practically all of the larger ones occur near expansion and dummy joints. The basis of the graphs is 10 ft., so that deflections which occur within 5 ft. of joints are considered as being due to joint influence.

The pavements, of which records were made have expansion joints every 50 ft. with a dummy joint half way between. Soon after construction the dummy joints cracked through and in effect became contraction joints, then the area within 5 ft. of all the joints is 40 per cent of the total area of the pavement.

If the rating due to joints were in proportion to the area affected by them, it would be 40 per cent of the total for the section of roadway recorded. A segregation of those deflections due to joint influence reveals that, usually almost twice that proportion, or 80 per cent of the rating appears to be due to joint influence.

A detailed study of the individual graphs indicates that the pavement slab curled as shown in diagram at (a) Fig. 3. Then when the transverse cracks appeared, shown as (b) Fig. 3, they permit the slab to roll, allowing the high deflections at the joints to subside. This reduces the rating and the road has better riding qualities, particularly in the dry season. However, even after the transverse cracks appear, the rating is best in the wet season.

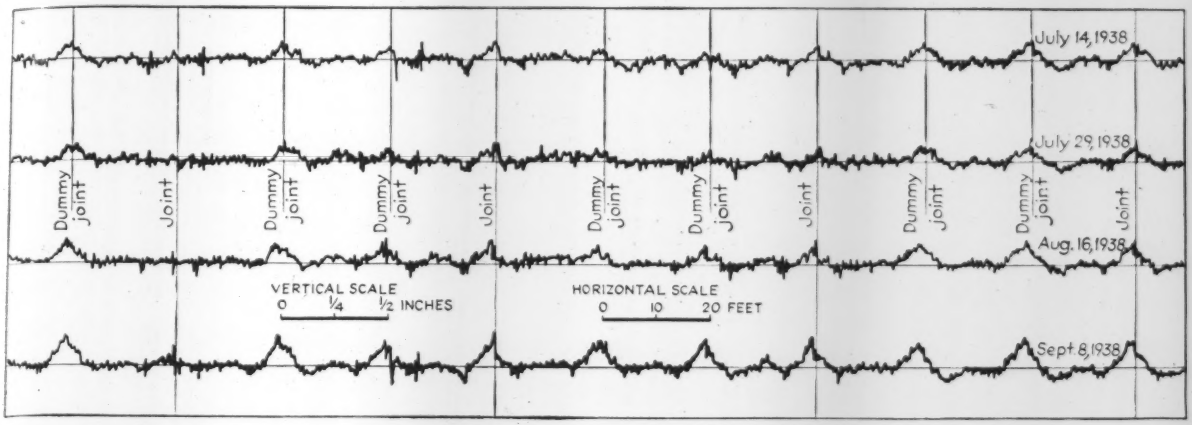


Fig. 2. Roughness records are taken regularly of Los Angeles County pavements and are checked with weather conditions.

Some soils used for subgrade swell as moisture is absorbed and some engineers have advanced the theory that high deflections at the joints are due to swell in the subgrade near the joints. If this were the case, it seems that during and immediately following wet weather the deflections would be at their maximum. Actually, at that time, by the use of the recording surface meter and by the use of a straight edge, the writer has determined that, in most instances they are at their minimum. Also if swell in the subgrade near the joints was responsible for these deflections, the transverse cracks, when they appear, would be at the vertex of a sag, but a study of the surface graphs and an examination of the cracks themselves show that they are at the vertex of a spur.

While undoubtedly there are some instances where the curl in concrete pavement is exaggerated by swell in the subgrade near the joints, by far the greater number of cases observed by the writer are believed to be due to moisture content differential between the top and bottom portions of the pavement.

The writer believes that the reason for the reduction in deflection magnitude (curl) immediately after moisture precipitation is due to the absorption of the precipitated moisture by the upper part of the pavement thus elongating it.

Practical conclusions

From the foregoing it appears that the following conclusions may be drawn:

1. To reduce the unpleasant jar, sometimes felt while crossing the joints in otherwise smooth concrete pavements, the minimum expansion allowance that can be made safely should be provided. This allowance should be made in a number of thin joints rather than in fewer wide ones.

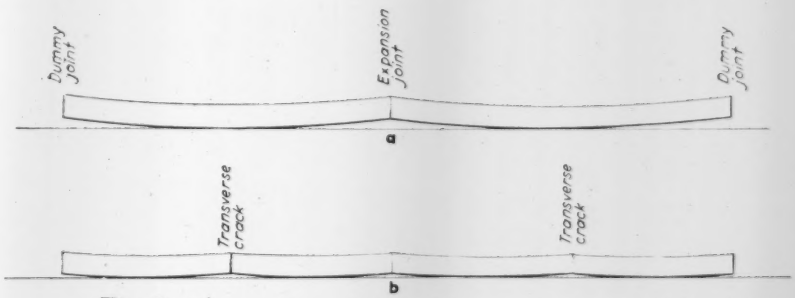


Fig. 3. How cracking reduces curl in concrete pavement slabs.

2. To reduce the tendency of adjacent slabs to become vertically offset one from the other, on adverse soils, use dowels at all expansion, dummy and cold joints.

3. To reduce the accumulated effect of slab curl at any one point and to reduce the number of unsightly transverse cracks, the distance between dummy or contraction joints should be shorter than it has been in the past.

4. Finally, to reduce the rate of slab curl there are a number of steps which it seems could be taken:

Abrasion does not play as great a role in the destruction of pavements as it once did, so that probably we can reduce the cement ratio, thus reducing the coefficient of shrinkage, and still develop sufficient strength to bear the loads imposed by modern traffic. The savings made in reducing the cement ratio can be used to build a thicker slab, which would reduce the rate of curl.

If the subgrade where it makes contact with pavement slab is dried off one source of moisture, and probably the principal one, is cut off from the lower portion of the slab. This would tend to bring the upper and lower parts of the slab to a more nearly equal moisture content, thus reducing the rate of curl.

A selected, well drained material of low capillarity, used as a cushion or foundation just under the pavement slab, probably will break the capillarity and facilitate the drainage away from the slab of any water which may seep down through the joints; such material probably would have the additional advantage of a small swell coefficient. If the soil under the cushion of selected material be water-proofed, but little moisture can come into contact with the under side of the pavement slab. This would tend to reduce the moisture differential and thus reduce the rate of curl.

Appreciation is hereby extended to Geo. W. Jones, road commissioner of Los Angeles County, California, to O. F. Cooley, assistant road commissioner, and to E. A. Burt, chief construction engineer of the Los Angeles County Road Department, for their parts in making the investigations possible.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

GREEN RIVER BRIDGE ROCKPORT, KY.

OWNER: Kentucky Department of Highways, Frankfort; Lamar Riney, resident engineer.

PROJECT: Three contracts covering construction of a highway bridge across Green River, Rockport, Ky. Contract A includes piers and abutments; contract B covers the superstructure, which consists of one 700-ft. cantilever truss span, seven 120-ft. deck truss spans and six 50-ft. I-beam spans; contract C includes 2.284 miles of grade, drain and traffic bound limestone approach roads. Stipulated contract times are as follows: "A" 250 days; "B" 365 days; "C" 365 days. Interference with navigation is not permitted. Transportation facilities by rail, highway and water are available.

BIDS: Bids on the three schedules were received Oct. 26, 1938. On contract A, three bids, from the contract low of $156,102 to $177,601 were received; on contract B, ten bids ranged from the contract low of $204,426 to $249,822; on contract C, eight bids were received, ranging from the contract low of $156,268 to $202,874. Minimum labor rates are as follows: skilled, $1.00 per hr.; semi-skilled, 65c. per hr.; common, 40c. per hr.

LOW BIDDERS: Contract A

1. Spencer & Ross, Inc., Detroit (contract) $156,102
2. Dravo Corp., Pittsburgh 169,586
3. Rieth-Riley Construction Co., Goshen, Ind... 177,601

SUBSTRUCTURE

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Cl. "A" conc	3,299 c. y.	$25.00	$35.00	$22.00
2. Reinf	317,960 lb.	0.05	0.06	0.05
3. Creo. piling	10,710 l. f.	1.00	1.20	1.00
4. Steel H piles	5,200 l. f.	2.75	2.80	2.50
5. Struct. excav. (Item 1)	4,338 c. y.	7.00	1.00	14.00
6. Struct. excav. (Item 2)	2,333 c. y.	1.00	1.40	2.00

LOW BIDDERS: Contract B

1. Bethlehem Steel Co., Bethlehem, Pa. (contract) $204,426
2. Illinois Steel Bridge Co., Jacksonville 207,831
3. Midland Struct. Steel Co., Cicero, Ill. and St. Louis Structural Steel Co., East St. Louis, Ill. 211,533

SUPERSTRUCTURE

7. Cl. "A" conc	1,439 c. y.	18.00	18.00	17.00
8. Reinf	321,030 lb.	0.04	0.04	0.035
9. Struct. steel	2,682,650 lb.	0.0595	0.0608	0.0645
10. Lead plates	3,750 lb.	0.15	0.12	0.12
11. Navigation lights and conduit system (combined)	L. S.	4,100.00	4,030.00	2,000.00
12. Toll house and storage house (combined)	L. S.	1,400.00	1,500.00	350.00

LOW BIDDERS: Contract C

1. Perry McGlone Construction Co. and Clark Kearney Stark Co., Lexington, Ky. (contract) $156,268
2. J. F. Mulligan, Inc. and T. F. McMenamin, Greenville, Ky. 159,566
3. Ralph E. Mills Co., Frankfort, Ky. 174,222

GRADE, DRAIN, ETC.

13. Clear, grub	45.53 acre	60.00	30.00	30.00
14. Roadway excav.-uncl.	129,857 c. y.	0.26	0.425	0.40
15. Struct. excav. uncl	1,258 c. y.	1.00	1.25	1.30
16. Uncl. borrow	169,591 c. y.	0.26	0.22	0.23
17. Scarifying, reshaping	1,600 s. y.	0.05	0.10	0.10
18. Remov. conc. headwalls	2 ea.	20.00	5.00	7.00
19. Final dressing	97 sta.	3.00	10.00	12.00
20. Cl. "A" conc	1,208.26 c. y.	20.00	16.75	25.00
21. Cl. "D" conc	43.5 c. y.	40.00	50.00	60.00
22. Steel reinf	256,140 lb.	0.035	0.04	0.04
23. 20-in. precast conc. piles	4,859 l. f.	4.25	4.00	4.50
24. Bank protection	5,000 s. y.	2.00	1.50	1.50
25. Bronze exp. plates	885 lb.	0.60	0.40	0.50
26. C. I. gratings	2 ea.	30.00	25.00	40.00
27. 15-in. corr. metal pipe (ent.)	64 l. f.	1.20	1.50	1.50
28. 24-in. corr. metal pipe (ent.)	32 l. f.	2.00	3.50	2.50
29. 18-in. reinf. conc. pipe (X-drain)	411 l. f.	1.70	1.75	2.00
30. 24-in. reinf. conc. pipe (X-drain)	112 l. f.	2.20	3.00	3.00
31. *Cr. limestone	3,785 ton	1.80	.....	1.90
32. *Bank or creek gravel	6,905 ton	.....	0.25	.....

* Alternate types for surfacing.

PARKING AREA SURFACING, CALIFORNIA

OWNER: Board of Education, Sacramento.

PROJECT: Constructing parking areas consisting of 3-in. cementing road rock course with a 1-in. bitiminous armor coat wearing surface, as follows: 45,000 sq.ft. at Sacramento Junior College, and 26,000 sq.ft. at McClatchy High School.

BIDS: Six bids were received Aug. 29, 1938, ranging from the contract low of $4,260 to $5,680.

LOW BIDDERS:

1. J. R. Reeves, Sacramento (contract) $4,260
2. A. Teichert & Son, Inc., Sacramento 4,790
3. McGillivray Construction Co., Sacramento.. 4,900

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Parking area	71,000 s. f.	$0.06	$0.0575	$0.069

BASCULE BRIDGE, ALPENA, MICH.

OWNER: City of Alpena, Mich.; H. M. Howe, city clerk. Clifford E. Paine, Chicago, engineer.

PROJECT: Constructing 280-ft. concrete and steel bascule span bridge, electrically operated over Thunder Bay River. Bridge is to carry a 40-ft. roadway with 2 ft. 8 in. sidewalks. Distance between main piers is 100 ft.; piers are 34 ft. across; two land spans are 53 ft. and 34 ft., and an additional girder span is 22 ft. Clearance above water is 8.5 ft. Stipulated contract time is 365 days. Transportation by rail, highway and water is available. Piers and center piles are sunk to rock 25 ft. below the surface of the water.

BIDS: Ten bids were received Oct. 14, 1938, ranging from the contract low of $255,573 to $319,384. Labor rates are as follows: skilled, $1.00 per hr.; common, 50c. per hr.

LOW BIDDERS:

1. W. J. Storen Co., Detroit (contract) $255,573
2. Owen Ames Kimball Co., Grand Rapids..... 256,225
3. Great Lakes Dredge & Dock Co., Cleveland.. 272,500

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Remove struct	L. S.	$12,000.00	$11,678.00	$6,400.00
2. South shore struct	L. S.	17,500.00	13,092.00	20,600.00

(Contract Unit Prices continued on second following page)